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Navy Foundry Covers Wide Range

New Shop at Norfolk is Equipped to Handle Gray-Iron, Steel and Nonferrous Castings — Exceptional Handling Facilities Provided to Care for Materials

BY S. W. BRINSON

A NAVY yard foundry may be considered a universal foundry, and of all the navy yard foundries the one at Norfolk, Va. perhaps is the most versatile through its equipment for making casting of gray iron, brass, other nonferrous alloys and converter or electric steel. This wide range of different metals cast, together with the varied facilities for making castings from a few ounces to many thousand pounds in weight, makes the Norfolk plant ably one of the most complete foundries in the country.

Previous to the outbreak of the war, in fact for several years preceding, the old foundry building which had been erected sometime about 1855 and which had not been constructed nor intended for a foundry was a source of much grievance for the men employed therein. The officials of the yard agreed with the men that the conditions were not what could be expected in a building built especially for the purpose, and that better conditions could not be brought about in such an old building. The men not only went to the navy department but also to the naval affairs committee of congress with their grievances, but still no relief was given until after war was declared and more output was needed.

On August 23, 1917, work was begun on a building for a foundry which would take care adequately of the needs of the yard. This building was completed and first occupied about October 15, 1919. The electric furnace was started at this time in order to meet the need for steel. This building is 180 x 400 feet and has a 100-foot foundry yard and a 55-foot gallery extending its entire length. The main bay is 80 feet wide and 95 feet high and is served by an 80-ton bridge crane on an upper track, two 15-ton bridge cranes on a second level track and four 5-ton traveling wall jib cranes on the lowest track. In the bay under the gallery three 2-ton bridge cranes with power on the lift only, run on tracks which are

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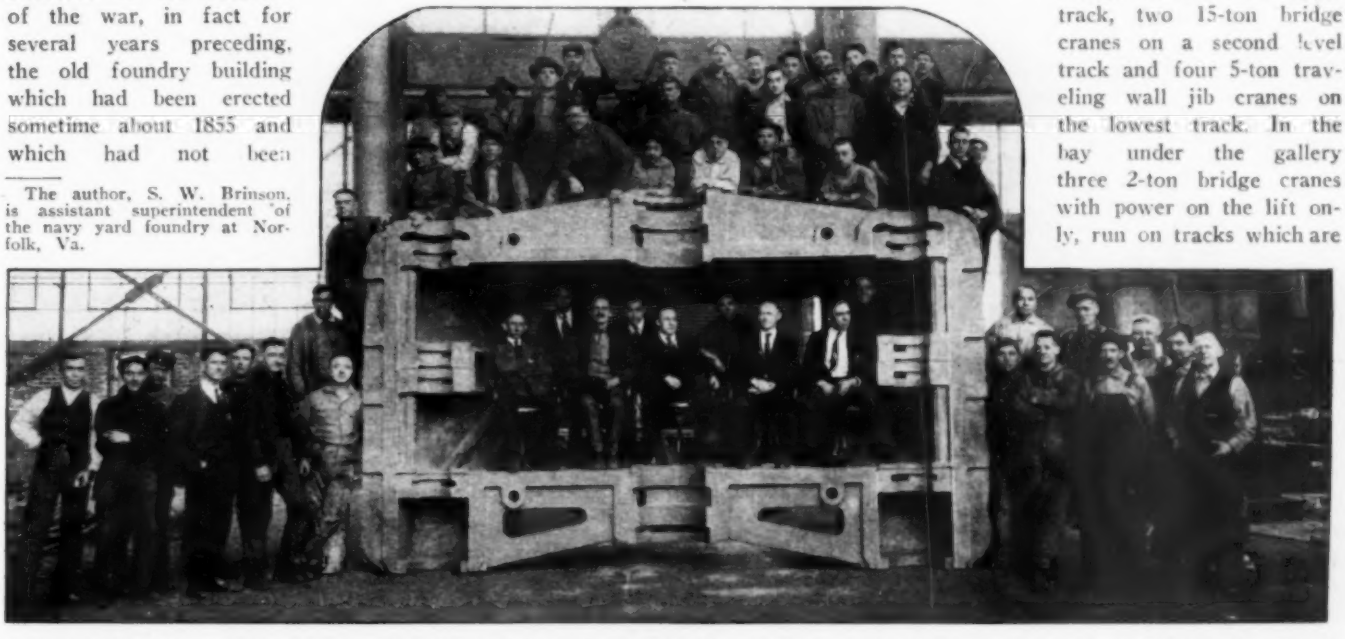


EXCEPTIONALLY LARGE STEEL CASTINGS MAY BE HANDLED WITHOUT DIFFICULTY IN THIS UNUSUALLY WELL EQUIPPED PLANT—THIS 35,000-POUND PIECE IS FOR THE REDUCTION GEAR CASING OF A PASSENGER VESSEL

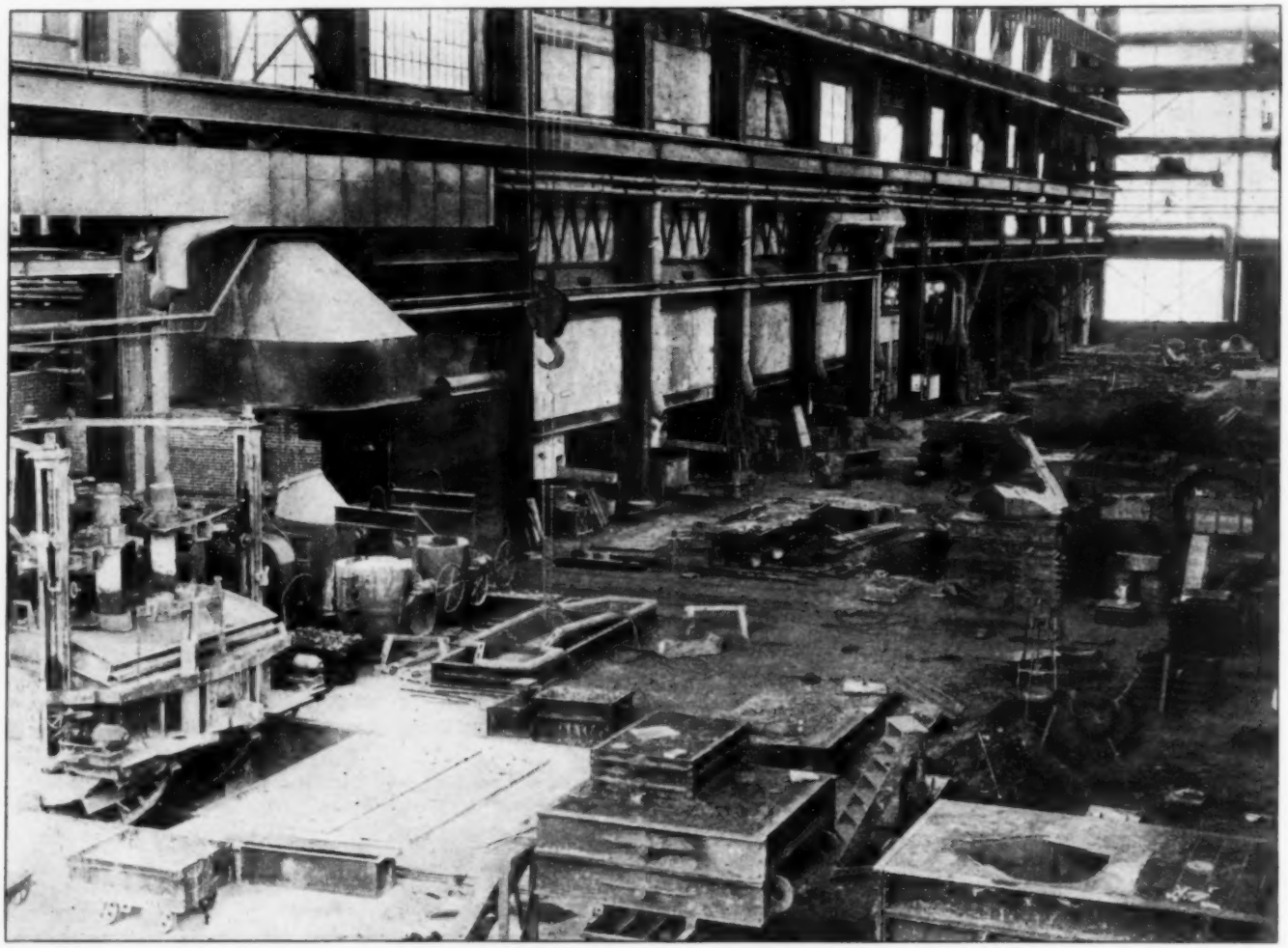
traverse to the main bay and projecting into the main bay. These three cranes cover three longitudinal bays and serve two large molding machines. Two similar cranes in the other side bay are located between the large core ovens and the annealing furnaces. The bay under the gallery is covered also by a monorail system in the cleaning room and the brass molding floor. In the side bay next to the foundry yard a 5-ton bridge crane spans the entire bay and covers five longitudinal bays; this crane serves the flask room and also the transformer room for the electric furnace. In the yard a 10-ton bridge crane commands the entire yard.

The charging floor is situated 22 feet above the main floor on the melting side of the shop with a blower room located on a mezzanine floor 10 feet above the main floor. Both of these are fully enclosed. The charging floor is served by a 3-ton elevator and a platform which projects 8 feet into the foundry yard and covered by the yard crane. A narrow gage track system which covers the shop crosses the elevator to the charging floor. The gallery also has four loading platforms projecting into the main bay so that material may be handled to and from the gallery by the main bay cranes. A 3-ton elevator and a spiral stairway also serve to convey material from the main floor to the gallery.

On the yard side of the foundry, a series of concrete bins for sand and other such bulk material have been built. These bins are heavy and are built onto the foundry building. These bins have hatches in the top for filling by the yard crane and have outlet doors opening into the main building. They are so divided as to hold approximately six months supply of the materials that they contain and are supplemented by two additional bins separated from the building out in the foundry yard nearby.

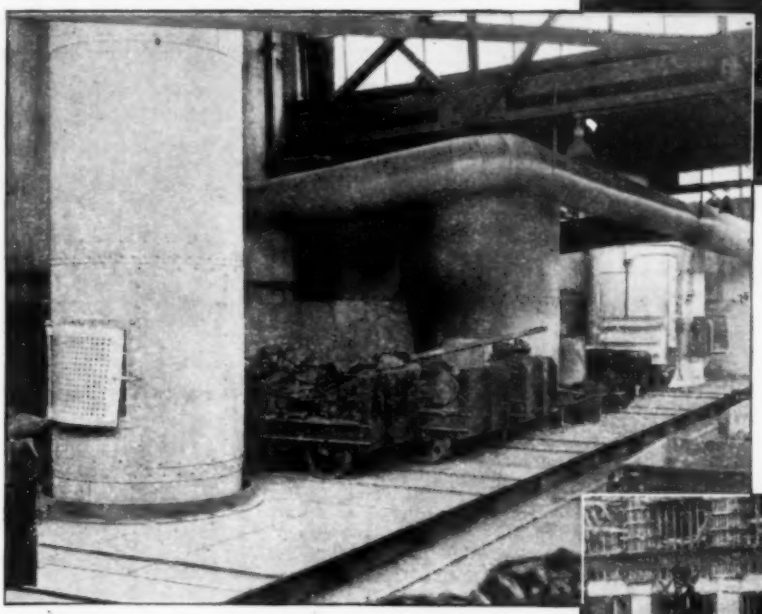
The yard is 400 x 100-feet. It has a storage capacity of 2000 tons of scrap iron, 130 carloads of pig iron, 30 carloads of coke, 500 tons of steel scrap and a space 72 x 100-feet for the storage of flasks. This storage is in addition to the bins already mentioned. Pig iron is stored in wooden bins holding one carload each and all the iron is mixed by analyses supplied for each carload. These bins are 7 x 7-feet and 10 feet deep. The iron is put in and removed from the bins by an electric lifting magnet, this arrangement saving a great deal in the loading and unloading of the bins as the iron is dropped in the bins and not piles as was necessary before the bins were built. The coke storage is built around the two separate concrete bins. The coke bin has a concrete floor and the sides are 10 feet high and made of creosoted timber. The coke is removed through four hatches located at the bottom and is conveyed to the foundry on industrial cars. It also may be removed from the top by a single line grab bucket and landed directly on the charging platform.

The foundry has both standard gage and industrial tracks. One standard gage track enters the building from the yard side. This track comes through the new pattern shop, which is now being built, across the foundry yard and into the main bay of the foundry. Another standard gage track ex-



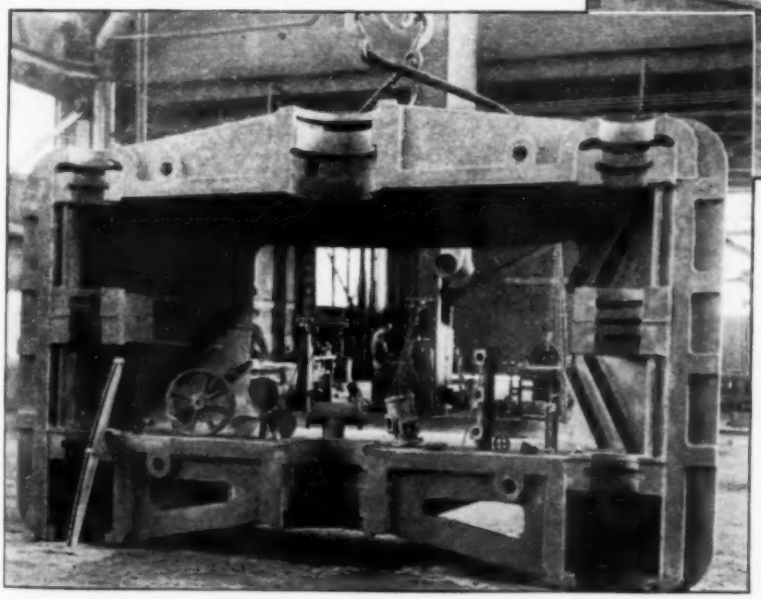
FOUR CUPOLAS, A CONVERTER AND AN ELECTRIC FURNACE ARE GROUPED ALONG ONE SIDE OF THE EXPANSIVE FLOOR, WHILE OVERHEAD CRANES COVER EVERY PORTION OF THE SHOP

THE CUPOLAS ARE SEPARATED FROM THE MAIN FLOOR BY A CURTAIN WALL, WHILE THE CHARGING FLOOR AND BLOWER ROOM ARE ENTIRELY ENCLOSED—NOTE THE SPLASH COAMING BELOW EACH SPOUT



SHORT SPUR TRACKS TERMINATING IN A TRANSFER TRACK WITH A CAR MAKE IT POSSIBLE TO REACH EITHER SIDE OF EACH CUPOLA WITH CHARGING MATERIAL

EACH CARLOAD OF PIG IRON IS PLACED IN A SEPARATE BIN AND ACCURATELY MARKED FOR IDENTIFICATION—COKE AND SAND ARE ALSO CONFINED IN BINS AND ALL MATERIALS ARE BENEATH THE YARD CRANE



THE DISSIMILAR CHARACTER OF THE WORK HANDLED MAY BE NOTED FROM THE CASTINGS SHOWN—THE SMALL GAS ENGINE CYLINDER MENTIONED IS TO THE RIGHT OF THE CENTER

tends from the large sand blast room on the yard side across the entire building and a street and into the receiving end of the machine. This track in its course also passes through the cleaning room. Another standard gage track enters the end of the building. This is the only track which enters the building without going through some other shop. It extends across a street and then connects to the yard system. Ulitmately it is intended to locate the cleaning room across this street, away from the main building, in which event this track will be used for handling the castings from the foundry and thence to the other shops. A standard gage track for supplies extends down the foundry yard along-side of the sand bins. The industrial track reaches the most remote portions of the yard and extends completely across the foundry, past the brass furnaces and to the gallery elevator. This track crosses the charging floor elevator and is also shunted around it. A branch track extending back of the cupolas for the removal of slag and cupola dumpings connects to the cross track by a turn-table. Also all right angle connections in the yard are made by turn-tables. The turntables are all of the smooth-top style.

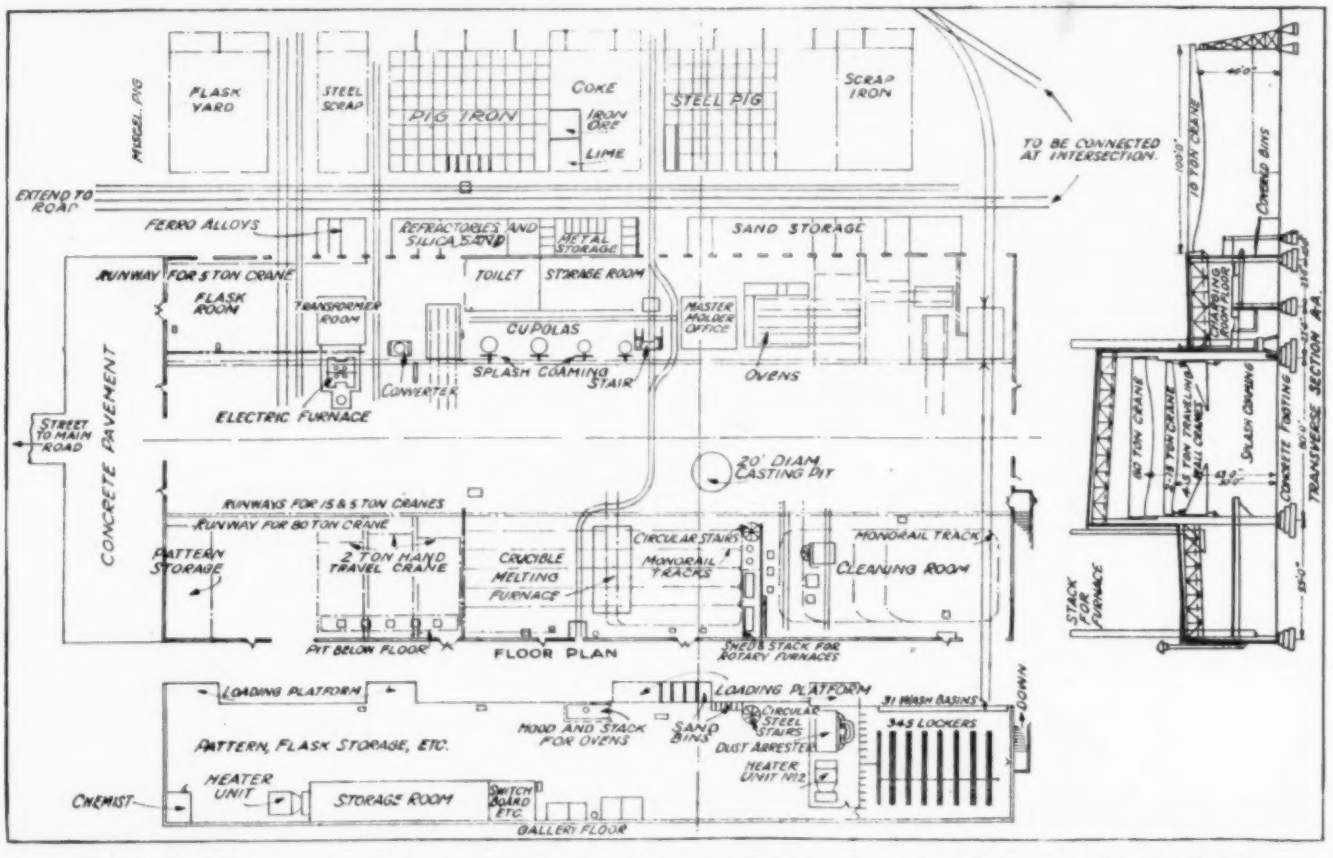
The industrial track commands the entire charging floor. Tracks extend to each side of every cupola and in the case of the 84-inch cupola the tracks run onto the charging machines. Cars are brought up on the elevator and are placed on the desired tracks by two transfer cars operating on tracks extending transversely to the other tracks.

Facilities for Weighing

One of the transfer cars that is used is equipped with scales. Three 6-ton platform track scales are located in the foundry yard on the industrial track and one 6-ton and one 10-ton platform scales are situated in the cleaning room. Exceptionally large castings are weighed on crane scales. The equipment for melting the iron consists of 48-inch, 60-inch, 72-inch and 84-inch cupolas. A combined melting capacity of about 60 tons per hour may be attained. However, the 60-inch cupola is used almost entirely for melting iron for the Tropenas converter. The 84-inch cupola is equipped with two pneumatic charging machines. The tapping spouts of all the cupolas are the same height above the floor level.

The two larger cupolas were manufactured by the Whiting Corp., Harvey, Ill., and the 60-inch by the J. W. Paxson Co., Philadelphia. All the cupolas have a single line of tuyeres, and are equipped with blast meters made by the Charles J. Clark Blast Meter Co., Gladbrook, Ia. Air is supplied by blowers manufactured by the P. H. & F. M. Roots Co., Connersville, Ind. and also by a centrifugal compressor made by the General Electric Co., Schenectady, N. Y.

The brass and non-ferrous melting equipment consists of 22 pit furnaces, 18 of which are lined for No. 150 crucibles and four for No. 80 crucibles. This gives the pit furnaces a combined melting capacity of approximately 30,000 pounds of brass per day. These pits are set flush with the floor and are covered by a complete overhead monorail system. They may be used with either oil, coal or coke for fuel. Two 600-pound, double-chambered, Rockwell, open-flame furnaces and two 300-pound white metal pots also are provided. A galvanized iron hood completely encloses the Rockwell furnaces and exhausts directly outside of the building. Draft for the pit furnaces is supplied by a 95-foot, self-supporting, steel stack. The pit furnaces are located about midway of the brass floor and are placed in a concrete box foundation lined with red brick. The Rockwell furnaces and the white metal pots are set against a brick partition which separates the cleaning room from the



PLANS AND CROSS SECTION SHOW CHARGING FLOOR ARRANGEMENT AT NORFOLK NAVY YARD FOUNDRY

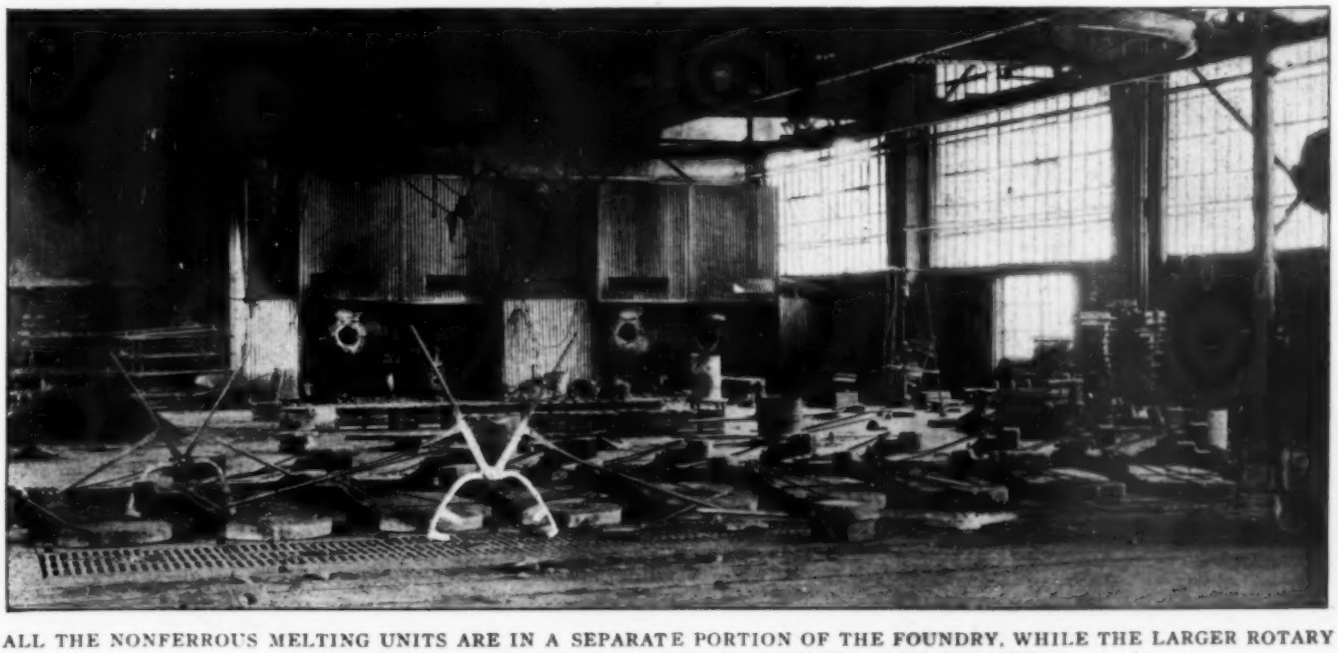
brass molding floor. The steel melting equipment of the foundry consists of a 6-ton, basic lined electric furnace, manufactured by the Electric Furnace Construction Co., Philadelphia, and a 2-ton, acid lined, Tropenas converter. With these two furnaces a steel casting of approximately 7 tons net weight can be made. In fact, the yard recently made castings of 15,000 pounds net weight which have been previously described, for battleships now building. An oil-fired, mold drying oven 15 x 26 feet with two cars is situated next to the converter. At the cleaning end of the shop are two car-type, over-fired, annealing furnaces, one 9 x 18-feet and the other 12 x 20-feet, for annealing the steel castings.

THE CLEANING ROOM IS EQUIPPED WITH SPRUE CUTTERS, STATIONARY GRINDING WHEELS, TUMBLING BARRELS AND BOTH CABINET AND ENCLOSED SANDBLAST ROOMS—A MONORAIL COVERS THE ENTIRE AREA

In addition to the mold drying oven which can be used for cores, a battery of three additional core ovens 7 x 27-feet, with cars, and one 4-drawer oven for smaller cores are built on the main floor. These ovens are in a side bay under 2-ton cranes and face the front of the small annealing furnace and the side of the large one, which faces into the main bay. The space between the ovens and furnaces is used for making large cores. The small cores are made on the gallery floor on which is another battery of core ovens consisting of two transrack and one roller drawer ovens. The core ovens were provided by the Foundry Equipment Co., Cleveland.

The small core room on the gallery floor has small sand bins built on one of the loading platforms and the mixer travels on rollers in front of these bins. Coremaking benches, which were designed by the yard, are used and a coremaking machine is used for making round and square stock cores. Space is provided on this floor for the core storeroom and for the temporary storage of large patterns. A small chemical laboratory for the preliminary tests on the electric steel is situated in one corner.

The floor of the foundry is paved except for two spaces in the main bay. In the side bay next to the yard concrete was used. In the bay under the gallery and at the ends, wooden block on a concrete base were used. Vitified brick was placed under the cupolas. A concrete trucking passage, 7 feet wide, crosses the main bay about the middle of the sand molding floor, the industrial track being embedded in this passage. A 7-foot woodblock, trucking passage extends from one side to the other, adjacent to the side floor under the gallery. The sand molding floor is covered with 18 inches of Lumberton sand and two rails embedded in concrete set at the main floor level have been placed lengthwise in order that the sand floor can be maintained at the proper level. A molding pit 20 feet in diameter and 20 feet deep also is set in the main floor. This pit is made of a steel



ALL THE NONFERROUS MELTING UNITS ARE IN A SEPARATE PORTION OF THE FOUNDRY, WHILE THE LARGER ROTARY FURNACES ARE HOODED TO PREVENT THE FUMES FROM ESCAPING

tank with 12 inches of concrete on both the inside and outside. As this pit is not used often to its full depth, it is also used as an emergency storage for sand.

Extensive Molding Facilities

Molding machines of great variety are used. These include types from small snap-flask machines to a 50 x 60-inch plain jarring machine. This large plain jarring machine is placed in the main bay and has a concrete box around the foundation, so that the machine can be kept clean and properly oiled. A rollover machine made by the Tabor Mfg. Co., Tacony, Philadelphia and a rollover machine built by the Herman Pneumatic Machine Co., Pittsburgh, are located under two of the 2-ton side bay cranes. These machines are set in a molding machine pit 80 x 7-feet and 7 feet deep. This pit is covered by concrete slabs, has a stairway at one end and is electrically lighted. In it there is space for one additional machine.

The cleaning room is situated in the corner of the building nearest the machine shop. The cleaning equipment consists of sand blast equipment, three sprue cutters with a capacity up to 2-inch square steel, three swing grinders, seven double end grinders, vise benches. All the sand blast machinery, including one 30 x 40-inch sand blast barrel, one 40 x 50-inch sand blast barrel, one 8-foot room-table sand blast with an industrial track and one 18 x 25-foot two machine sand blast room with standard gage track was manufactured by the Pangborn Corp., Hagerstown, Md. A testing bench for pressure castings and a welding bench are also available in the cleaning room.

The flask room is situated in the corner of the building next to the flask yard. This room is equipped for fitting both wood and iron flasks.

The toilet is on the main floor between the cupola room and the sand bins and the locker and wash rooms are on the gallery over the cleaning room. The wash room is completely enclosed and has an enclosed stairway leading to it on the outside of the building. This stairway leads directly into the shop through a vestibule. The wash room is equipped with individual lockers and wash basins and also with shower baths. A metal partition divides the white section from the colored.

The storeroom is located the same as the toilet. In addition to the storeroom, two of the concrete bins are used for the storage of nonferrous metals. One of the unique features of the storeroom is the storage of oils. These are contained in tanks on the outside of the building and under the charging platform and pipes from them run into the storeroom.

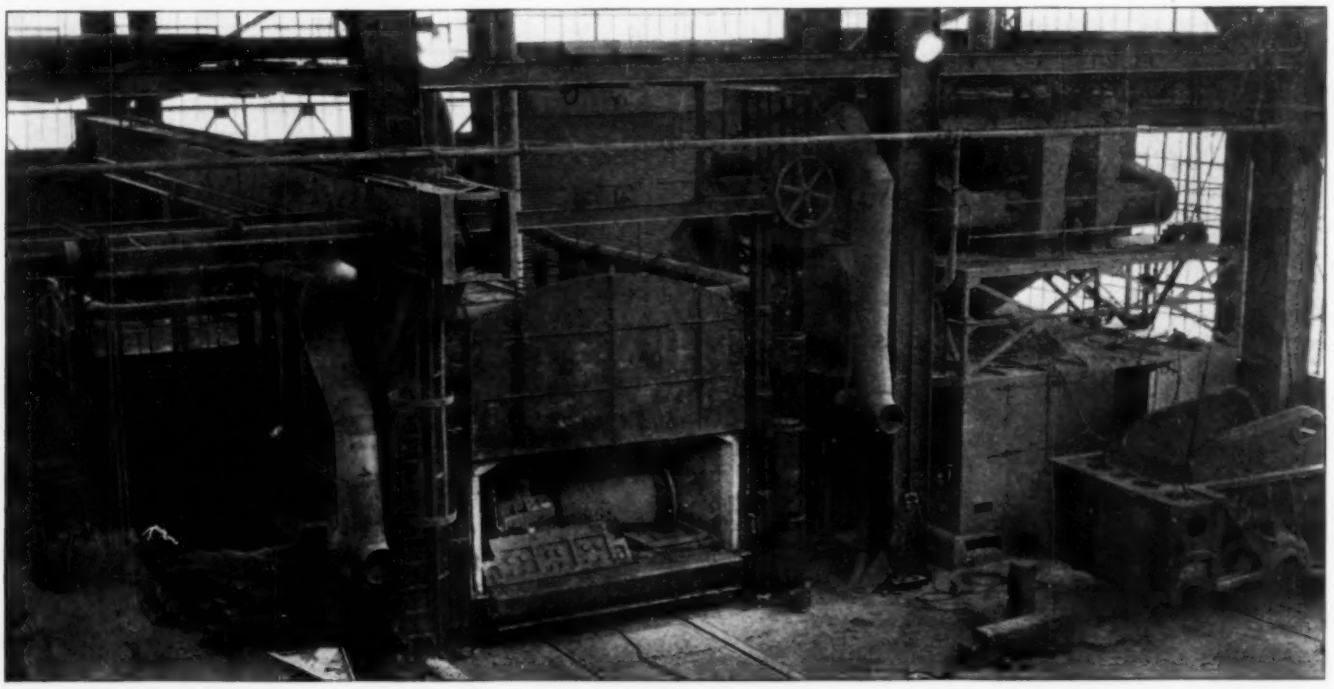
Shop Management System

The organization of the shop is as follows: The master molder is in complete charge of the shop. Under him are two quartermen molders, three leadingmen molders, two planners, one inspector and a flask man. One quarterman has charge of the iron and steel floors and at present has one leadingman under him. The other quarterman has charge of the brass floor, core room, cleaning room and planning, having at present two leadingmen under him, one for the brass floor and one for the core room. The planners route and ship the work. The inspection is handled by the inspector who comes under other than shop authority.

Have Cores Ready

When an order is received in the foundry from the pattern shop, the planner makes the necessary instruction cards for the shop. In cases where cores are involved, three cards are made, one for the core room, one for the molding floor and one for the shipper. The card is not sent to the mold floor or shipper until the card is returned from the core room as completed, this insures that the necessary cores are always reading for the molder when the mold is made. The number of supervisors of course is dependent on the size of the force and the amount of work on hand. The flask man gets the flask ready for a job. A welder for repairing slightly defective castings is assigned to the shop, as is also an electrician and a machinist for maintenance.

In a foundry such as has been described it is impossible to put in a system of molding, pouring and handling of castings such as can be put in a shop which handles only special work. Still in laying out the shop an effort was made to do this in the most efficient way, in the face of the difficulties to be overcome. The only standardized work of sufficient quantity going



EXCEPTIONALLY LARGE ANNEALING OVENS ARE REQUIRED TO ACCOMMODATE SOME OF THE STEEL CASTINGS MADE—NOTE THE MANNER IN WHICH THE DOORS ARE COUNTERWEIGHTED—THE LARGEST SANDBLAST IS AT THE RIGHT

THE FOUNDRY IS WELL LIGHTED AND THE HIGH MONITOR ROOF AFFORDS GOOD VENTILATION

through the shop are castings for navy-type, gasoline engines which are manufactured at this yard. An effort is made to handle this work as far as possible the same way that it is handled in commercial concerns making this a specialty but as this work forms only a small percentage of the output of the shop, the difficulty of doing this can be easily seen. The gasoline castings as far as possible, are placed on molding machines and in the case of water-jacketed work the cores are jigged, these cores being made up and stocked in the core stock room. The only other standardized work is that such as grate bars, valves and other similar articles which are used in quantities in the navy; but as these are made at all the yards the quantities made at any one yard is not sufficient to justify making a specialty of them, except in a few instances.

Heavy Work Capably Handled

The castings made by the foundry will run in weight from a few ounces each to 35,000 pounds which is the largest casting yet made, three such having recently been made for a commercial concern in the vicinity. The castings possess all degrees of intricacy, and in the nonferrous field almost every alloy ever made at times is called for, some of which when made commercially require the services of specialists. The repair work, which as a general thing is urgent, is constantly interfering with the schedules for the manufacturing work, this of course not only upsetting the routine and planning in the foundry but also in the other shops involved.

It has been stated that a brass, iron and steel foundry cannot be operated commercially under the same roof with success, but that is what has to be done in a number of navy yard foundries. Added disadvantage and obstructions are found, such as having repair work and production work mixed up, having to make whatever alloy is called for and in some instances of getting the casting out in a length of time that does not permit of the painstaking care being given. Under these conditions a navy yard foundry is expected to turn out castings just as good, just as quick and just as cheap as commercial concerns which make a specialty of one particular class of work. In other words a navy yard foundry making brass, iron and steel all under the same roof, and especially at the Norfolk yard where a number of gas engines castings are made, has to cover the same ground that commercially is covered by from five to ten different foundries operated by as many organizations.

To Fix Manganese Duty

Some apprehension has been aroused among importers of ferromanganese by a report that the metals subcommittee of the house ways and means committee is recommending a duty of 1c a pound, or $22.40 a ton, on ferromanganese imports. Protests to the subcommittee have been met with the reply that a duty of such proportions is not being considered.

The Payne-Aldrich tariff duty on ferromanganese was only $2.50 a ton, it is pointed out, and while the new rates will be higher, they will not approach $22.40 a ton, the importers have been told. Domestic producers of ferromanganese have asked for a duty of $44.80 a ton.

Members of the Southern Tariff association in conference with the metals subcommittee yesterday urged duties sufficient to make possible the resumption of manganese, quicksilver, graphite, bauxite, zinc and ferroalloys industries in the southern states.

Acquires Facilities of Lancaster Iron Works

W. W. Posey, president of the Lancaster Iron Works, and A. C. Sculley, secretary of the same company, recently were elected to the directorate of F. J. Ryan & Co., Philadelphia. This will add to the facilities of the latter company and will enable it to design, manufacture, erect and install its products solely through its own organization. Further, the Ryan company will control the sales and installation of all Mirc fuel fired equipment.

Secures Plant of a Carbide Company

The Air Reduction Sales Co. has secured control of the National Carbide Corp. of Virginia, with a new plant at Ivanhoe, Va., and beginning May 1 directs the policy and controls the operation and sales of the Carbide corporation. With the acquisition of this carbide plant the Air Reduction Sales Co. can sell within its own organization everything necessary in the use of the oxyacetylene flame. Its products now include oxygen, acetylene, welding and cutting apparatus and supplies, acetylene generators, carbide, nitrogen and argon.

Die-Casting Methods and Metals-II

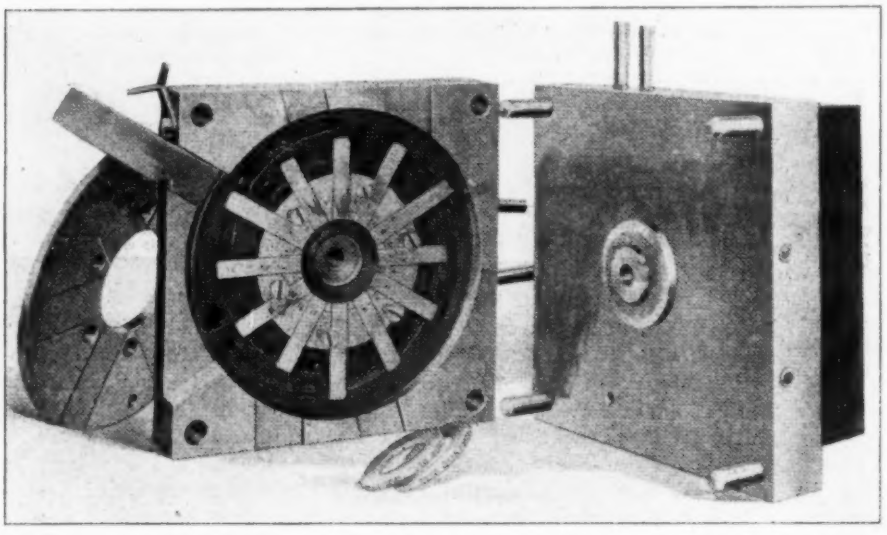
Data Regarding the Various Metals and Alloys Which May Be Die Cast is Given and Comparison Is Made Between Results From Casting in Sand and in Dies

BY M. H. POTTER

THE process of die casting is such that only a limited number of alloys can be die cast commercially. Such metals must have a fusing point and shrinkage which will not be so great as to injure or destroy the metals of which the dies and casting machines are made.

The molten metal to be die cast must be held in a compression chamber and subjected to high pressure. Metal must be used for the compression chamber, since no other material has the required strength and wearing qualities at the necessary working temperatures.

Metals when molten have a tendency to alloy with other metals coming into contact with them even though such metals are far below their fusing temperature. For instance, molten zinc in an iron pot will eat away part of the iron and gradually destroy the pot. The dissolved iron forms an alloy with the zinc and after an excessive amount of iron has been absorbed the zinc becomes unsuitable for use. The metals which may be die cast are therefore first limited to those which may with practical results be handled in metal pressure chambers and dies.



WHEEL DIE—TWELVE SLIDES ARE FASTENED TO ROLLERS TRAVELING IN CAM SLOTS IN THE CIRCULAR PLATE

The degree of pressure applied has a marked effect on the grain and quality of the work. Pressures applied vary from 200 to 1000 pounds per square inch, according to the work to be produced. The casting or pressure chamber must therefore have a high tensile strength at temperatures ranging between 800 and 1300 degrees Fahr., the points between which die castings are poured.

The velocity at which metal enters the dies is tremendous, and, at the temperature used, quickly will cause the destruction of dies made from poorly selected metals or not properly treated and prepared. The shrinkage of castings in the dies subjects them to great strain and wear. This problem does not exist when casting in sand, as in that the mold gives as the metal shrinks. The metal to be die cast, when solidifying, must have a certain amount of elasticity, or otherwise in shrinking against cores in the dies it will crack.

Aluminum alloys subject the portions of the dies against which they shrink to great wear, as they have a high shrinkage and fall substantially below their fusing point before being removed from the dies. It is apparent, therefore, that when the shrinkage and tensile strength of the metal to be die cast exceeds a certain point no die material can be found which will withstand the strain.

Another important consideration in determining the metals which may be die cast is the necessity of maintaining the metal continuously in a molten state in the machine or in an adjacent crucible. In some metals this causes excessive oxidation and occlusion of gases and impurities, resulting in porous, imperfect castings low in tensile strength.

This condition does not exist in sand molding, as the molds are first prepared and the entire pot of metal then poured in a comparatively short space of time. The die-casting machine operates only one mold, but works it continually, requiring that a given quality of metal be constantly in readiness for casting.

While the molten metal is in the casting machines it is stirred by means of a device attached to the machine, keeping the formula constant and bringing oxides, gases and impurities to the surface. Strong, solid and accurate castings cannot be produced from metals which by reason of their sluggishness, shrinkage, high fusing point, tendency to dross, brittleness at high temperatures below fusing, etc., seriously interfere with production in the casting machines.

Die Casting Alloys

The accompanying table gives representative metals for die-casting work. Variations in any formula are harmful and also greatly reduce and hinder production. The most satisfactory aluminum alloys to die cast are those generally known in the trade as aluminum-copper alloys, and contain from 5 to 20 per cent copper. Aluminum-copper alloys are stronger and harder than pure aluminum and are more easily finished and machined. The addition of copper to aluminum besides increasing the tensile strength, reduces the fusing point and shrinkage making the metal more suitable for die casting. In die casting aluminum it is not always desirable to hold to any particular copper content, but this may be increased or reduced as the casting condition warrants. Die castings may be made satisfactorily with an aluminum-copper alloy having as much as 22 per cent copper

Zinc strengthens aluminum more than copper, but it is not suitable for die casting, as the high temperature at which the metal must be maintained for extended periods causes it to burn out and dross excessively, destroying the good qualities of the alloy. Under normal markets aluminum though comparatively high in cost per pound, really is no more expensive than the cheaper white metals, due

to its low specific gravity. For instance, a casting weighing one pound in No. 12 aluminum alloy will, if made in the following metals, have the weights as shown:

	Pounds
Copper	3.2
Brass	3.0
Cast iron	2.6
Lead	4.0
Zinc	2.5
Bronze	3.1

Lead and aluminum do not mix, having no affinity for each other. Lead is a harmful impurity to aluminum, but can be present only in small amounts as the metal will not hold it. Tin is harmful in aluminums. It causes excessive brittleness in time and the castings will disintegrate. Not more than 1.5 to 2 per cent of iron should be present in aluminum alloys, as otherwise it becomes too brittle.

Zinc alloys containing various proportions of tin, copper and aluminum, or only one or two of these metals, have been used since the inception of the die-casting industry. They are cheap in comparison with other white metals, but considerably more expensive than cast iron, which they resemble in brittleness. They should not be used under heat conditions exceeding about 150 degrees Fahr., but may temporarily be subjected to between 250 and 300 degrees Fahr., according to the composition of the alloy.

Chilling Increases Strength

Pure zinc is too brittle and soft to be die-cast and flows sluggishly. When alloyed with tin, copper or aluminum the crystals are materially reduced, producing a finer grain and a much tougher and stronger metal. Its shrinkage is also thereby reduced and it flows more readily. The rapid chilling in the die greatly increases the strength and toughness of the metal.

Tin alone does not increase the tensile strength or hardness, but softens the metal, makes it flow more readily and prevents a certain amount of shortness or cracking. In excess of about 8 per cent it performs no useful function and does not combine well.

Copper toughens and strengthens the metal but should not be added over 3.5 per cent, as then it increases the fusing point to such an extent that excessive drossing and oxidation are caused in the casting machines.

When added to zinc, aluminum reduces the dissolved or imprisoned oxides within the metal, forming alumina which floats to the surface and is skimmed off. It is also valuable because it forms an extremely thin coating of aluminum oxide on the surface of the die casting and this prevents the alloy from soldering or sticking to the dies. Aluminum in small percentages also makes the metal flow more readily and strengthen and toughens the alloy by deoxidizing it. More than 0.5 per cent of aluminum should not be added in zinc alloys containing tin, as above this amount it will cause deterioration.

All metals when molten have a tendency to absorb atmospheric and fuel gases; oxides also are occluded and held mechanically within the metal. This latter property is well illustrated in the thick scum on the surface of zinc alloys before fluxing. This scum consists of an intimate mixture of metals and oxides and rises to the top because of its lower specific gravity. To free the metal from oxides the most suitable flux used is sal-ammoniac.

Tin, when die cast, is usually combined with varying proportions of antimony, copper and lead or only one or two of these metals. It may also be cast pure. Tin alloys are not brittle, but have low tensile strength. They are easy to cast because of their low fusing points and the fact that the metal flows readily in the dies. One of the chief uses for the tin alloys is in the composition of bearing or anti-friction metals known as babbitts.

Lead alloys are cheaper than the tin alloys, but not nearly so tough. They have similar casting properties and are greatly toughened by the rapid chilling in the dies.

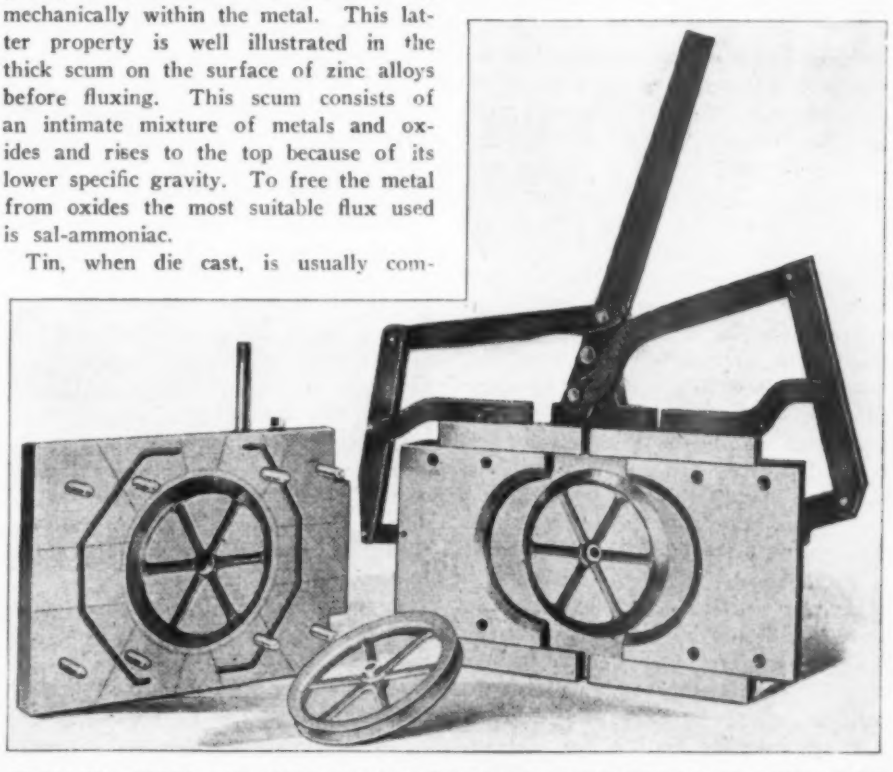
Design and Construction

Die-casting dies probably present more difficulties in design and workmanship than any other dies. Their life depends entirely upon their construction, the character of the metal both for the die and the castings made in them, the design of the piece to be made, the care they receive, etc. Naturally, a die for a delicate piece, having many moving slides and cores, will not last as long as a simple die under the same conditions. The important part which workmanship and material play in the life of a die, as well as in the quality of its product cannot be emphasized too strongly.

Although design and construction have a most important bearing on the accuracy, finish and grain of the castings, it is frequently difficult to determine whether defects in castings are due to dies or

Representative Metals for Die-Casting Work

Per Cent					
Tin	Copper	Lead	Anti-mony	Alu-minum	Description
	10			90	Used for mechanical parts of all kinds. Tensile strength 18,000 to 21,000 pounds per square inch. Less than half the gravity of cast iron.
84	7		9		High grade babbitt for high speeds and heavy loads.
83	5		12		Used for delicate parts required to be accurate. Tensile strength comparatively low.
61	3	25	11		Good grade babbitt of medium cost.
		87	13		Low-cost antifriction metal for light loads and medium speeds. Also used for machine parts not requiring strength.
			Zinc		
6	3	½	90	½	Used for mechanical parts. Tensile strength 12,000 to 16,000 pounds per square inch. Gravity about the same as cast iron. Should be protected from moisture by a coating or plating.



TROLLEY WHEEL DIE—NOTE HOW THE GROOVE IS FORMED BY SLIDING PARTS OPERATED BY A SINGLE LEVER

other causes. Inaccuracy may be due to a number of causes. If constant—that is, alike—in all castings, it is almost always due to an error in the size of the die or shifting or warping of the die parts.

The dies are cut from a solid block whenever possible. This is often more expensive than *building up* an impression, but it is much more satisfactory in results. Many constructions, due to the design of the part, must be built up of several pieces and in such work the greatest care must be used. Molten metal under high pressure will creep into the slightest crevices. All die parts must therefore be perfectly fitted. The high pressure and hard wear to which they are subjected require substantial construction. Long practical experience is necessary to properly direct work of this kind. The heat at which dies are worked and the constant heating and cooling which takes place will cause them to warp badly if steps are not taken to overcome this. For this reason all dies are heat treated to take all the internal strains out of the metal and protect its surfaces from the destructive action of the molten metal.

When inaccuracy varies in different castings of the same heat or run it may be due to a number of causes. If the error is across the parting line it may be due to particles of dirt or metal on the die surfaces holding the sections apart. In old-style casting machines it may be due to wear in the clamps or toggles used to hold the dies shut, or to their weakness. When a casting is made the pressure under which the molten metal enters the die has a tendency to open it and when large castings are made the strain on the dies is great, running as high as 15 tons per square inch. Undue variation in die temperature, especially in large parts, also causes inaccuracy. Water-cooled dies are therefore used, inasmuch as the flow of water can be regulated.

All die surfaces coming into contact with molten metal must be finished by polishing dies. All surfaces rubbed by the castings in ejection can have no tool marks or depressions and must be absolutely smooth and slightly tapered to free the casting the moment it begins to move out.

The gating of the castings is a subject of constant study and no fixed rules can be applied. Castings, according to their size and design, are affected by the width, thickness, shape and location of the gate as well as by the direction it enters the casting. Improper gating will cause poor finish and porous castings.

For parts of tin, zinc or lead alloys the die impression is made of machine steel. It should not be hardened except for special purposes, as the expansion and contraction will cause it to crack and check. Cast iron is seldom used for die impressions because its porosity has a tendency to make castings stick to it and show poor finish. Drill rod and tool steels are used for ejector pins, cores, slides, etc. Soft machine steel cannot be used for dies for aluminum. Alloy-steel dies give the best results and often an average of 200,000 castings are made from a single die of such material.

Shrinkage of castings is allowed for in the dies, so no allowance should be made in drawings. When dies for single pieces are made this allowance may be calculated accurately. The shrinkage of complicated pieces is held back by portions of the die against which they shrink, and the amount of shrinkage in many such cases can be only approximated. Experience has developed great skill in this respect and by working *safe*—that is, so any inaccuracy may be overcome by taking a little more metal from the die, wonderful results are obtained.

How To Register Patterns on Matchplate

BY P. H. ROOT

THE method for registering patterns on a wooden matchplate described by A. Landerer on page 259 of the April 1 issue of THE FOUNDRY, while undoubtedly accurate, in my opinion, is entirely too elaborate and entails altogether too much trouble. We use a great many cherry matchplates and this is a subject with which I am particularly familiar. Had I been making the valve patterns described I should have turned up the drag patterns with a ⅝-inch diameter stem, long enough to extend through the matchplate and cope patterns. I should then turn up the cope patterns and bore a ⅝-inch hole through the center of each one. When the patterns are assembled on the plate the long stem will bring each cope and drag half accurately into line. The holes in the matchplate may be made loose as they do not affect the fit of the half patterns.

White metal would make more durable cope patterns. The holes in the center could be drilled accurately after the patterns were cast and finished. We recently completed some white metal patterns about 6 inches in diameter with an irregular parting line that extended in places through the cherry matchplate. The matchplate was 13-16-inch thick. Each half of the pattern was made in white metal. The cope half was plain, but the drag was provided with a ⅝-inch stem in the center about 2 inches long. Both halves of the pattern were turned true in the lathe, then the stem on the drag half was turned down to ½-inch in diameter and a ½-inch hole was drilled in the cope half to correspond.

A rough hole considerably larger than the stem was made through the matchplate so the drag pattern could be adjusted in its proper place. The drag patterns were fastened with flat head brass screws and in many cases a cherry gate was sawed out and attached.

With round patterns it was necessary only to slip the cope patterns over the stems and fasten them down with screws. With square patterns or those of any other shape, of course it becomes necessary to insert a dowel pin in one corner.

In making cherry matchplates I have been using a cast iron end strip ⅜-inch thick fastened with from seven to nine flat-head, ¾-inch, or No. 10 wood screws. In addition to preventing the board from warping, these strips furnish an iron surface for attaching the guides. Two small lugs about 5 inches apart are cast on the drag side of these strips. They are drilled with a 13/64-inch drill to receive loop handles made of 3/16-inch rod. We have used these handles for over 25 years and considering their advantages I am surprised that they are not used more extensively. They remain folded flat against the under side of the plate until the flask has been rolled over, then they are pulled upright and used for drawing the pattern. The iron strip is extended to provide an attachment for a vibrator at a 45-degree angle.

We use our own design of guides and guide pins with the opening of the *V* turned toward the flask. If there is any *give* to the cope the guides will become tighter as the ramming progresses. The guides attached to the patterns are 1¼ inches long and extend 1 inch below the parting line. This feature is of considerable assistance in drawing the pattern.

I have found that cherry matchplates are serviceable and easy to make. We now use them with white metal patterns for all new work going into snap flasks. The patterns for the iron strips should be planed up and mounted on a matchplate. I make them 14 inches long and cut them off for narrower flasks.

Foundry Design Needs Study

Foundry Buildings Should Be Designed with a View of Co-ordinating the Structure with the Demands of Operation and Protecting the Equipment Against the Elements

BY J. H. HOPP

IN DESIGNING a modern foundry the engineer must first of all take into consideration the practical operation of the plant when completed. Following this a careful study must be made of the class of castings to be made and the quantity which it is proposed to handle. While it is true that this consideration applies particularly to foundries proposing to engage in quantity production it is just as applicable in the case of jobbing or any other variety of casting plant.

The building to house the various operations carried on in a foundry can be constructed in different ways and of many kinds of materials; but it should be designed with but one thought in mind, namely, that of co-ordinating with the plan of operation, and serving as a protection against the elements. Unfortunately the usual plan of procedure seems to be first erect the structure and afterward try to find an ideal plan of operation to suit the building.

In addition to fulfilling the conditions outlined the building must be designed in such a manner that molding operations can be carried on, at least by day, without the aid of artificial light. No buildings devoted to general manufacturing purposes require such efficient ventilation as foundries on account of the amount of gas, steam and dirt ever prevalent.

Must Have Railroad Facilities

The question of selecting the most favorable or suitable foundry site usually involves no other consideration than that it shall be adjacent to railroad facilities and on occasion even this feature is overlooked. The site not only should be ample to provide for future growth but also should be located in the best relative position to the remaining units of the plant. Another item which cannot be disregarded is the disposal of the waste products. Property suitable for filling at certain points is more desirable than level ground.

A few foundries conducted along radically different lines—some poorly equipped and others over-equipped; some without system and many overburdened with system—have, by their financial success, exploded any theories as to the necessity for careful study or scientific operation. However, without stating the various and obvious reasons therefor, every practical foundryman of broad experience with finance knows that no business, especially a foundry, can afford to operate along doubtful lines.

Sand Should be Covered

The majority of foundrymen know that while "pigs is pigs" all pig iron is not alike. This is true of the other materials. Apparently so negligible a thing as sand (and it is spoken of lightly on account of its comparatively low cost) can so greatly reduce a given day's profits as to more than make worth while the separate storage of each car of sand purchased. At times, and under certain conditions, not only would it be unnecessary but unwise to separate certain sands, depending upon their use in the foundry or core room. From the foregoing general statement only one conclusion can be drawn, namely, that the proper and separate storage of raw materials is not only vital but essential to success.

The material storage yard considered ideal by builders of foundries is one wherein the yard area is served by a crane with a magnet and clam shell bucket. This equipment is a valuable adjunct—but its installation without thought as to breakdown or without thought as to the kind of cars in which the raw material is received, or the nature of the material to be handled, is one of the most common mistakes made.

Many foundrymen consider the ideal condition one in which the yard is served by a crane delivering the raw materials to the charging floor, generally by magnet. It can be proved quite clearly that in many cases this method is not the most satisfactory. The writer is aware that exception will be taken to this statement by many and justifiably so, but principally for the reason that they have not studied the operations incident to the making up of their charges carefully. Many foundrymen do not believe it is necessary that the materials be weighed separately or as a whole.

Foundrymen are prone to throw up both hands in utter horror at the thought of heating the buildings in which the sand is stored. The word "buildings" is used advisedly. If those to whom this method does not appeal had some method of recording the amount of scrap produced as a result of frozen or wet sand they would agree that heated buildings for sand storage are a profitable investment. It is advisable not only that the sand be stored in suitable buildings but also that the coke be protected from the elements.

Those familiar with the practical operation of foundries realize that work in the open in all sorts of weather, perhaps digging pig iron out with a pick, is not a pleasant task and it is for this reason that the storage yard completely covered, and in some cases entirely enclosed, is not only preferable to any other system, but on account of the better working conditions should be the cause of less dissatisfaction among the men.

The charging floor area in many foundries is too small; provision should be made in arranging the area so that a surplus supply of material can be maintained on the charging floor to be used in emergencies. Even so simple a detail as the floor itself is neglected.

Keeping Things in Order

Blowers and compressors, together with driving equipment, generally are placed in the area left after equipment of lesser importance has been set up. Cleanliness in this direction and the possible damage from water seem to receive only passing thought. All of this has resulted in the almost universal condemnation of belt-driven equipment. Even the absolute necessity of supplying blowers and compressors with clean, cool air is considered by many as "getting things down too fine." This is also the general comment when suitable provision is made for washing the windows,

From a paper presented at the Columbus convention of the American Foundrymen's association. The author, J. H. Hopp, is connected with the Charles C. Kawin Co., Chicago.

particularly those in the generally inaccessible places. The windows are valuable directly in proportion to their ability to transmit light.

The recommendation that an elevator shaft be entirely closed generally does not meet with hearty approval, but when one considers the amount of grit and dirt arising in this shaft and that the greased guides will hold this grit, ultimately shortening the life of the parts applied, no further argument irrespective of the requirements of the law, should be necessary.

The erection of a foundry on a certain sized piece of property which will not permit of the most ideal conditions with regard to the size of the floors, and which will not permit the building being set far enough away from all surrounding buildings so as not to obstruct ventilation and light, is a mistake that forever precludes the possibility of maximum production.

It is not the purpose of this paper to enter into a discussion of the respective merits of various types of buildings from the standpoint of their original cost, upkeep, or ability to resist fire. It is, however, fitting to say that natural light can be hardly furnished to excess. This also applies to ventilation. The matter of heating, must be viewed from a somewhat different angle. The foundry must be heated sufficiently at all times to prevent the sand from freezing. This is possible in varying degrees by means of any of the systems in vogue. Certain systems, however, are able in the summer months to bring some relief from the abnormal heat conditions existing and in addition even during the winter period are able to bring about a change of air mechanically and in this manner make the foundry a more desirable place in which to work.

Cheap Light False Economy

On account of the general necessity of night work as well as molding on dark days, the problem of lighting a foundry is such that a study should be made of just what is required and of the areas that should be lighted best. It is false economy to run a few general conduits and drop a few carbon lamps from the ceiling. These statements with reference to the general procedure are by no means isolated cases, as the writer's opportunity to observe these points in hundreds of foundries proves that the majority of foundries pay little attention to such details.

The proper system of delivering water to the floors and air lines for supplying the molding machines is generally an after-thought. It is in this and similar problems that an engineer conversant with the practical requirements of the foundry can furnish his clients piping systems that will not necessitate tearing out hundreds of dollars worth of work to make a few additional connections.

With the growing tendency on the part of young men not to enter this industry, particularly as apprentices at a low rate of wages, the necessity of mechanical equipment without overburdening oneself with this sort of thing can be said to be essential to success. The limit in labor saving equipment in the foundry by no means has been reached, but considerable progress has been made and more progress will be made when a readjustment of selling prices becomes necessary.

The cutting of the sand heap by mechanical means, conserving for the molder that energy so necessary to production, has been a big step in assisting the molder. To accomplish this end the arrangement of the floors and the floor construction need to be taken into consideration if this work is to be done at a minimum cost.

Core Room Imporant

In the majority of plants to the writer's mind the core room presents an equivalent to the rest of the industry, comparable with the drafting room or engineering department of a manufacturing plant. Let there be the slightest opportunity for misconstruction of a figure, and arrow head or a line, and the machine shop, pattern shop and the foundry are ever ready with the timeworn alibi, "Well, it's up to the engineering department," or, "it's up to the core room." Often this charge is just.

In modern production the core room is a much more vital factor than ever before. Not many years ago a foundryman would look at the patterns of a prospective customer, view with dismay the cores as indicated by the prints, and say, "We don't want the job; we're running a foundry, not a core room." Today we are of one opinion generally, and that is that the difficult parts of the mold can be made best with cores. For this reason, coupled with the fact that skilled men or molders are becoming less plentiful each year, it is necessary that the core room be given considerable thought, not only the size but also the equipment and routine of the work as it progresses through the various stages until the assembled core is ready to be placed in the mold.

With the cores becoming a large factor in production as compared with the quantity of sand used, it has been found advisable and economical to reclaim this sand, not alone for its sand value but for such portion of the bonding elements as may remain. Many foundrymen still are satisfied if they secure a bake of cores over night from a given oven. It is common practice in other plants to see ovens occupying no greater amount of floor area producing several bakes a day, depending upon the nature of the cores.

Sand Blast Equipment

Generally speaking, a suitable shakeout area has not been considered necessary and it is common to find in foundries today, heaps of core sand, broken cores rods, anchors, etc., piled mountain high under the crane, in an area valuable as molding space, with little or no arrangement whatsoever for the convenient removal of this refuse. The problem of arranging for this is a neglected rather than a difficult one.

Not many years have elapsed since purchasers were content to receive castings which had been wire-brushed and chipped. Today there is a growing demand at least in certain classes of castings, to have them sand blasted. The crude methods of doing this work a few years ago under conditions that were anything but livable have been discarded. Now the operator is almost entirely free from the dust.

The location of such equipment must be determined in advance, as suitable pits and foundations are required and the equipment cannot be moved conveniently at will. Frequently the sand blast table, room or barrel, as the case may be, is located in some far away corner without thought as to what must be done with the castings after they are brought from the sand blast room.

There can be no question that all castings do not require to be sand blasted; therefore, the mill equipment of a cleaning room needs consideration. The progress of the castings from the foundry to shakeout in the larger work and thence to the cleaning room and to the various pieces of equipment therein readily can be predetermined, and the equipment for handling the castings so arranged as to assist in the loading and the unloading of the mills for the heavier work.

Every foundry should have suitable pattern storage facilities as well as

patternmaking and flask repairing departments. As the patterns in any foundry are valuable assets they should be protected from the possibility of destruction by fire. It is obvious that a building used for this purpose should be made as nearly fireproof as possible and should be separated from other buildings.

It seems unnecessary to state that patterns should be filed in a systematic manner with suitable records kept covering each one. All shelves must be flexible to permit the reception of patterns of various sizes. The method so commonly in use of having some one man around the plant who knows every pattern and when asked, "Can you locate it?" casts longing glances toward the heavens and answers, "I'll look for it," is surely not a satisfactory method for this day and age.

Pattern shops or patternmaking departments usually need the same sort of thought with reference to the layout, general placing of equipment, storage of lumber, etc., as would be incidental to the machine shop contemplating certain manufacturing processes. The proper arrangement of the equipment with reference to sequence of operations and arrangement of line shafting, shaving ducts, etc., is essential.

It is impossible in so brief a paper to discuss in detail every phase of so complex a problem, but it is not out of place to state that there is not one of us, who, if he will but reflect occasionally, will find in his own plant an opportunity to improve results and relieve the amount of labor required. If this association could secure from the manufacturers of this country a statement from time to time, as to short-cut methods and their application and the results following, it would furnish a basis for the future, data of inestimable value to the industry. In the absence of such data we are compelled to continue to design foundries which do not measure up to perfection, but getting as near as possible to it from the available data.

Prevent the Distortion of Light Castings

IT was my fortune for a number of years to have charge of an ornamental iron foundry where we were called upon to make a great many comparatively long, thin castings in an infinite variety of sections. The principal trouble with this class of castings is to get them straight and to prevent them from warping out of shape.

It is practically impossible in many cases to predicate which way the casting will go when it commences to contract. It is only after the casting has been made and shaken out and the distortion noted that the molder can decide on the proper precautions to observe to insure straight castings in the future. The usual remedy is to camber the pattern in the opposite direction from that in which it shows a tendency to warp. In other words, if the experimental casting is sprung up at the ends, the pattern is bent down at the ends and so on. If a person could decide in advance just how much camber to give a pattern, the pattern could be constructed along those lines. Unfortunately that cannot be done. The best that can be done is to approximate the probable twist as nearly as possible and make any necessary adjustments after the first casting has been made. This is expensive, especially when only one or two castings are required.

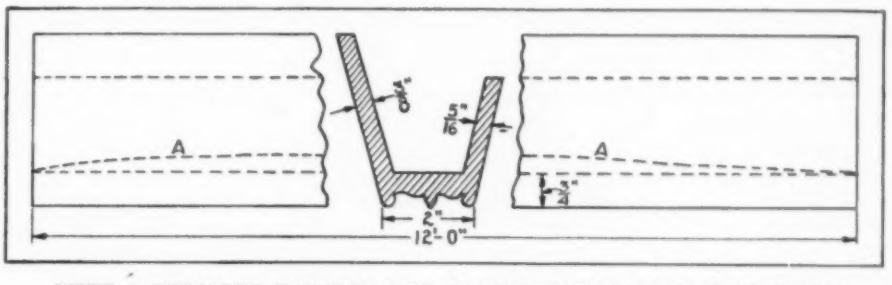
Those with considerable experience in this line of work can approximate closely the direction and probable extent to which a casting will warp and a great deal of trouble can be eliminated from the fitting shop if the patterns are cambered according to their advice. My experience with the casting shown in the accompanying illustration may be adapted by those having a similar problem.

The pattern was 12 feet long, one side 4 inches wide by ⅜-inch thick, the other side 3 inches wide by ⅛-inch thick. A deep cut egg and dart ornaated from the fitting shop if the pattern was finished made the bottom ¾-inch thick. The job was molded and cast in the position shown in the sketch from three hand ladles along each side. The pattern was supposed to be straight, but as a matter of fact was cambered slightly the wrong way.

In the foundry we tried to camber the pattern by springing it up in the center and placing weights on the ends to hold them down. This was done while the pattern was resting on the follow board. After a sufficient amount of sand had been placed in the drag to hold the pattern in place the weights were removed and the remainder of the drag rammed in the usual manner. We wished to camber the pattern at least 2 inches, but we experienced difficulty in springing it even ¾-inch and then the camber was not diffused evenly from end to end, in fact the pattern was kinky.

This is bad practice with a pattern of this character as we realized when the drag was rolled over and the follow board removed. The pattern sprang back to its original shape and allowed loose sand to trickle in and lodge in the ornamental face of the mold. The first casting came out 1½-inch concave on the lower side as indicated by the dotted line *AA* and also slightly concave on the wide or 4-inch side.

We tried to straighten it by heating and clamping it down on a surface table but the result was not satisfactory. The pattern had to be taken back to the pattern shop where it was partly sawed through at various points to try and get it into something like working shape. It may take a little more time and trouble to remake the pattern in a proper manner, but the resulting castings will be straight.



WITH A STRAIGHT PATTERN THE CASTING INVARIABLY WILL WARP

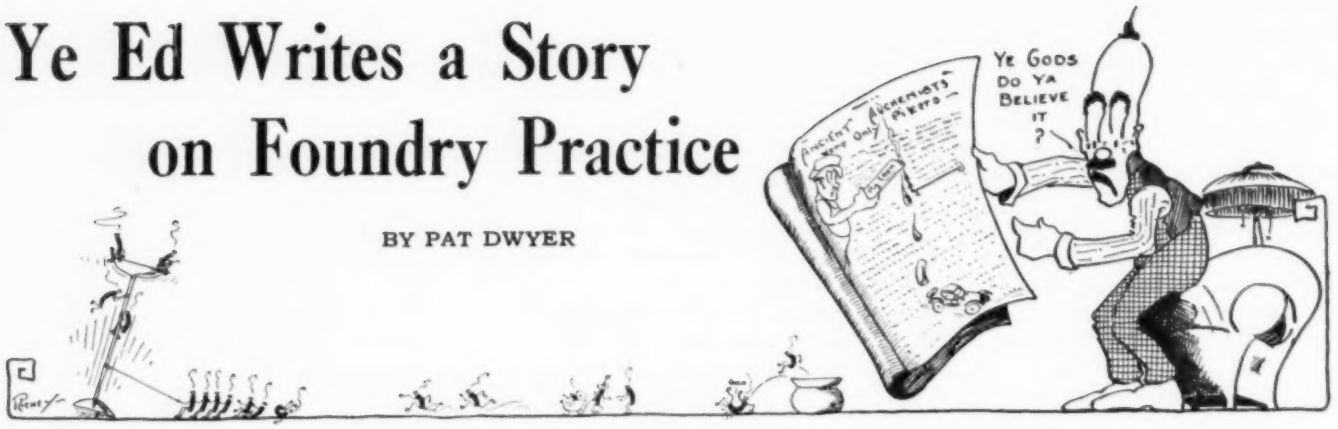
Furnace Company Consolidates Offices

The American Gas Furnace Co. has concentrated its entire personnel at its main office at Elizabeth, N. J., where its two plants are located. It also has discontinued selling through its former sole agents, E. P. Reichhelm & Co., Inc.

The Universal Crane Co., Cleveland, has removed its plant to a new factory at Elyria, O., where greatly increased capacity is afforded. The removal was effected by motor trucks.

Ye Ed Writes a Story on Foundry Practice

BY PAT DWYER



IN COMMON with millions of other peaceable and law-abiding citizens it has been my custom for many years to devote part of every Sunday to perusing the Sunday edition of one of the great metropolitan dailies. The magazine section particularly has appealed to me and I often have wondered where the writers gathered the material for their sensational stories. Recently I came in contact with one of these enterprising and gifted individuals and even helped in a mild way to secure material for such an article. He had been commissioned to write a story on the foundry industry and I had taken him out to Bill's shop to absorb the proper atmosphere and acquire the necessary data and statistics. As I regretfully announced in a preceding installment of these memoirs, a blacking bag exploding on the back of his neck broke up the seance and caused him to fly in wild confusion before he had finished his investigation. I wondered for some time afterward if the story was going to be a total loss, one of those mysteries of the sea where the vessel goes down with all hands

My anxiety was entirely without foundation. The story appeared last Sunday and after having read it I wondered why the writer had taken the trouble to go near a foundry for his information. Lack of space prevents me from quoting it in its entirety, probably some of you already have seen it and besides it was so extraordinary that a perusal of the entire text might lead some gentle soul to doubt my veracity or suspect that I was spoofing. However, a few gems, culled at random, will furnish a fair indication of the general substance.

The story, vividly illustrated in three colors, covered a whole page. The illustrations, extended diagonally from the upper left hand corner to the lower right hand corner, depicted a brawny giant holding one end of a large block of something, presumably iron, in one hand while he applied a torch to the other end. The metal apparently melted and ran in a succession of large drops across the page gradually assuming shape until they emerged at the lower right hand corner as classy little runabouts racing out of the page. The story was entitled.

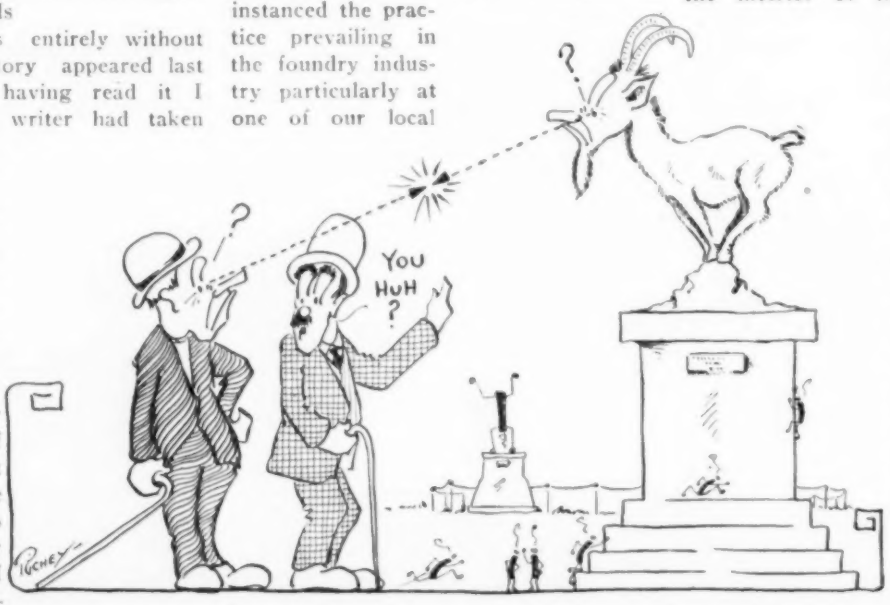
ANCIENT ALCHEMISTS WERE ONLY PIKERS.

TRANSMUTING BASE METAL INTO GOLD A MODERN ACHIEVEMENT.

The introduction was historical dealing in considerable detail with such well known and outstanding figures connected with the iron industry as The Iron Duke, The Man In The Iron Mask, Old Ironsides and The Iron Claw.

Coming down to specific details he instanced the practice prevailing in the foundry industry particularly at one of our local iron works whose product was known all over the world. A delicate tribute was paid to the head of the firm who alone and unaided, except for a few paltry millions left him by his father, had financed the huge corporation and who also was responsible for its success and phenomenal growth. After giving figures and a chart which in a graphic manner showed the past history of the plant and also indicated what the future had in store, he plunged directly into the manufacturing processes practiced by the company. I regret to say that *plunged* is right. The only mystery to me is how he ever managed to come to the surface again

"The molders as the men are known who prepare the forms into which the molten iron is poured are recruited from the rougher element of the population. Their manners and clothing are uncouth to a marked degree and they evince little respect for their appearance or for that of any visitor who is foolish enough to venture within the zone of their activity. Many of the processes involved in the production of castings are shrouded in mystery known only to the duly initiated and for that reason the interior of the foundry is kept dark so that outsiders may not purloin the secrets. For the same reason the windows of buildings devoted to the casting of metals never are washed. Each molder is provided with a pile of clay which he spades over every morning and removes the castings which he may find therein. He then proceeds to fashion the clay into molds and after he has used all his clay in this manner he fills the molds with molten iron. The lids are removed to allow the mold to cool and also to allow the molder an op-



WHAT'S THAT WHEEZE ABOUT SEEING OURSELVES AS OTHERS SEE US?

portunity of inspecting the casting and if necessary adding a little molten iron to remedy any defective parts.

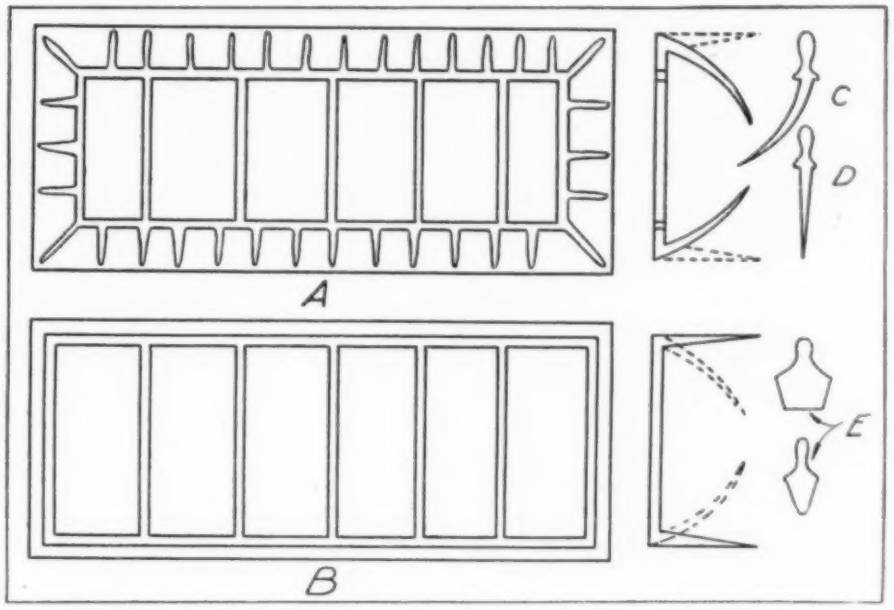
"The raw iron comes from the blast furnace in the shape of huge billets any one of which is a load for a strong man. It is placed in a furnace known in foundry parlance as a *Cute Below*, probably from the same perverted sense of the fitness of things which leads the foundryman invariably to refer to it in the feminine gender. Here it is melted at an intense heat which purifies it and separates the dross from the commercial iron. The dross or slag floats to the top where it is skimmed off and the pure liquid iron is drawn off through a spigot in the bottom of the boiler." Bill came in shortly after I had finished reading the story and I asked him what he thought of it. "Well," said he, "I suppose it does not matter. When you come to figure the thing out and take it by and large, as the saying goes, it does not make such a great deal of difference one way or another. Now does it? The majority of the people who read that story know little and care less how castings are made and you know that what a man does not know will never do him any harm or keep him awake at night. What a blessing it would be if castings could be made in as simple a manner as that indicated by our hero.

"Years of training are required before a man is qualified to handle some classes of work and even in those cases where the molding problems have been reduced to a minimum, it is not uncommon to find wasters in the day's heat. Open sand molding generally is looked upon in the foundry as being of an elementary character and yet certain rules must be observed to secure satisfactory results. This is as good a time as any to finish the description of open sand work which I began the day our hero paid us the visit and departed so hurriedly and unceremoniously.

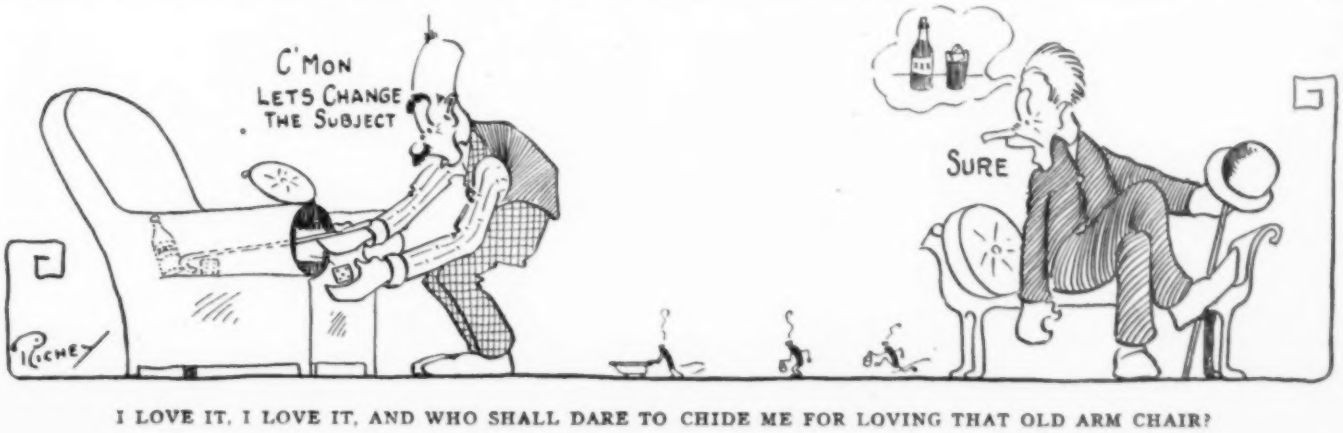
"As a general rule the two long straightedges forming the boundaries of the bed are taken up after the bed has been completed and before any attempt has been made to arrange the patterns or templates for the desired casting on its surface. This is done for several reasons. The first is that after the bed has been made they no longer are needed. The second reason is that if they are allowed to remain in the sand they will warp out of shape. A third reason is that they may be required to make another bed elsewhere and a fourth reason lies in the fact that if allowed to remain in position they are liable to be burned.

"In many shops, particularly those devoted to the manufacture of large machinery castings, a permanent bed is maintained in one part of the shop floor for making lifting plates, rings, core arbors, etc. It is in use practically every day, sometimes only a small part, but frequently the entire surface of the bed is required. Indeed in some days it may be necessary to lift the arbor and use the bed a second time. The two sides of the bed are defined by a pair of long, straight, steel rails set from 8 to 12 feet apart depending on local conditions. Core arbors are made by inverting the corebox and laying it face down on the prepared bed. It then is tapped gently to produce an impression or outline on the sand after which it is removed. A gate cutter is employed which simply is a piece of tin or thin sheet metal of any kind to scoop a channel in the sand corresponding in a general way to the inside shape of the box. Reinforcing channels are cut at various points according to the coremaker's judgment and experience. In this connection it is interesting to note that the style of arbor shown for a cylindrical core at *A* is to be preferred to that shown at *B*.

"Provision must be made in all cores for contraction of the casting. This purpose is defeated in the arbor shown at *B* and in extreme cases will result in ruptured casting and almost invariably will result in a distorted casting, that is one that is not truly round. Another objection to that style



THE METHOD OF MAKING A CORE ARBOR SHOWN AT *A* IS TO BE PREFERRED TO THAT SHOWN AT *B* THE SECTIONAL VIEWS SHOW ARBORS FOR BOTH RECTANGULAR AND CIRCULAR CORES



I LOVE IT, I LOVE IT, AND WHO SHALL DARE TO CHIDE ME FOR LOVING THAT OLD ARM CHAIR?

of arbor is that in rubbing the two halves of the core to a bearing before they are pasted pieces of sand frequently become detached from the edge of the arbor and the assembled core requires a considerable amount of patching. The arbor shown at *A* is just as efficient and has none of the objectionable features outlined.

"Instead of employing a gate cutter to scoop channels in the sand, some prefer to use a piece of wood shaped like the pean end of a rammer, *E* in the illustration. This piece of wood is used to stamp a continuous impression of the desired shape of the arbor. Many arbors of course are simply plain flat frames, but others are provided with *prickers* or *dabbers* of various lengths, either straight or curved, to furnish reinforcement to the body of the core. A piece of board sawed *with the grain* on the band saw is used for making the dabbers. It is shaped as at *C* for curved dabbers and as at *D* when straight dabbers are required. After the outline of the core has been cut or stamped on the bed the dabber is pushed down in as many places as are deemed necessary. Setting the lifting hooks in one of these arbors also is a job that requires care and discretion."

"Bill," I said, "will you kindly hesitate for a moment while I file a protest. You go jumping around like one of those long horned Alpine billy goats who spend their time leaping nimbly from crag to crag and from precipice to precipice, yodelling merrily meanwhile—or is it the natives who do the yodelling—I've forgotten; but anyyou know what I mean. Now, you are hard and tough, the words of course being used in the proper and legitimate sense and not at all in the sense which you probably have in your mind, but I have neither the strength nor the agility to follow you.

"First you start talking about open sand beds, from that you take a flying leap into core arbors, then hop nimbly on to the subject of setting lifting hooks. I am not a prophet or the son of a prophet, but I feel quite safe in predicting that your next stop will be in the blacksmith shop where the loops are made. From there it is an easy transition to the merchant mill, thence to the billet mill, the blooming mill, the open hearth steel furnaces, the blast furnace, the coke ovens and if you don't end up in a coal mine in the bowels of the earth it is because you will be standing on the edge of a huge excavation on the Mesabi iron range directing my attention to a gigantic steam shovel scooping iron ore into a string of gondolas a mile long."

"I may be some jumper," said Bill, "but I don't jump to conclusions like some people around here. There are only two of us present and I am not referring to myself. I had no intention of discussing the various processes involved in the manufacture of a steel bar. I was talking about core arbors and I maintain that I was perfectly justified in referring to the loops employed for handling them. You try making a big arbor and leave the hooks out and I bet when you come to handle the arbors or the completed core later, you will find yourself up salt creek without a paddle.

"I have neither the desire nor the inclination to introduce irrelevant matter but I like to give a subject as much consideration as the circumstances warrant. To change slightly the ancient wheeze of our childhood days: If you will kindly shut your mouth and open your long furry ears we shall get along faster.

"Once the bed has been prepared, subsequent proceedings, in case it is desired to make a plate, require more or less skill on the part of the molder, depending on whether a pattern is furnished or not. If a pattern is available it is a relatively simple matter to lay it on the bed and bank sand all around it. Usually it is sufficient to tramp the sand with the feet, but where the thickness of the plate exceeds 2 inches it becomes necessary to use the butt of the rammer.

In either case the superfluous sand is scraped off flush with the upper surface of the pattern, and after the runner basin has been built up the pattern is drawn out of the sand. For small plates, the sand is banked up and patted firmly with the hands into the form of a pouring basin, but where a large quantity of iron is to be poured pieces of pig iron or bricks are employed to reinforce the back and sides of the pouring basin. A row of long nails driven into the sand at the edge of the basin before drawing the pattern will prevent the corner from *washing* under the force of the stream of iron flowing over it.

"Many geometrically shaped plates can be made without the aid of a full pattern. Familiar examples are round and rectangular lifting plates. The only pattern equipment required for making a round plate is a segment-piece the thickness of the desired plate. The outside face is cut to form an arc of the circle. The approximate center of the bed is found by laying a straightedge first from two diagonally opposite corners and then from the other two corners. A wooden wedge is driven down into the sand at the point where the two lines cross each other. A pair of trammels is set to the required radius, allowing ⅛-inch to the foot for contraction, after which one point of the trammels is set on the wedge and the other point used to scribe a circle on the bed. The segment then is placed with the outer edge coinciding with the mark, a piece of pig iron or other suitable weight is set on to prevent it from moving and then sand is shoveled and rammed against it. The segment is moved around until the circle has been completed.

"A square or rectangular plate can be made with one straightedge. The outline of the plate is marked on the bed by using the straightedge as a guide and a carpenter's steel square for securing 90-degree corners. The straightedge, or a thickness piece if necessary is then placed to coincide with the mark, after which each side is banked up with sand and rammed in turn.

"Laying out the lugs on a lifting plate or defining the position of certain points on the surface also is a simple proposition if a few simple rules are borne in mind."

"If it's all the same to you, Bill", I said, "I move we adjourn. I have read and heard all the foundry *dope*, if you will pardon me for descending into the vernacular, I care for today and fain would converse on some other topic."

"Ods Bodkins and Gadzooks then," quoth Bill; "choose your weapons me lord and may a murrain seize me if I do not pink thee prettily on the wish bone."

Organize New Advertising Company

The Mears Richardson Briggs Co., Payne avenue and Twenty-first street, Cleveland, is the firm name of a new national advertising and merchandising organization which has been formed by Charles W. Mears, W. T. Richardson and Ralph E. Briggs. Charles W. Mears who formerly was publicity manager of the Winton Co., Cleveland, is president of the Cleveland Advertising club and ranks among the leading authorities on advertising practices. William E. Richardson was formerly vice president of Lord & Thomas, Chicago, and Ralph E. Briggs is a former magazine publisher and account executive in the advertising agency field.

The Electric Furnace Construction Co., 908 Chestnut street, Philadelphia, has closed a contract for a large electric heat treating furnace for the Yale & Towne Mfg. Co., Stamford, Conn.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

CAST STEEL FLASK CLAMPS

By George W. Childs

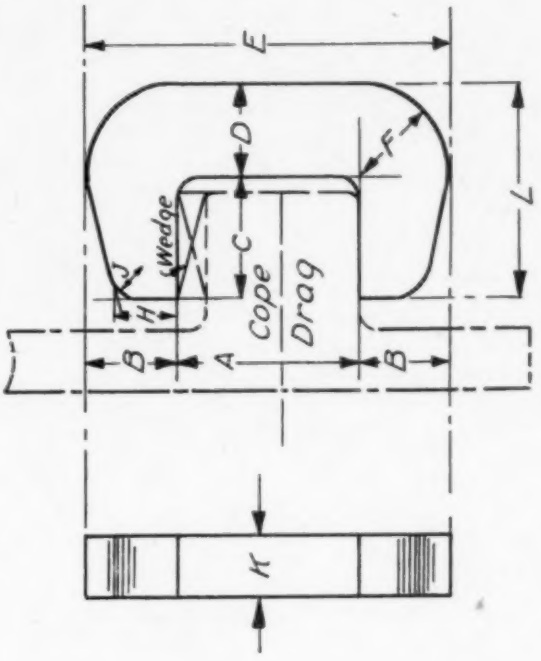


Table of Dimensions

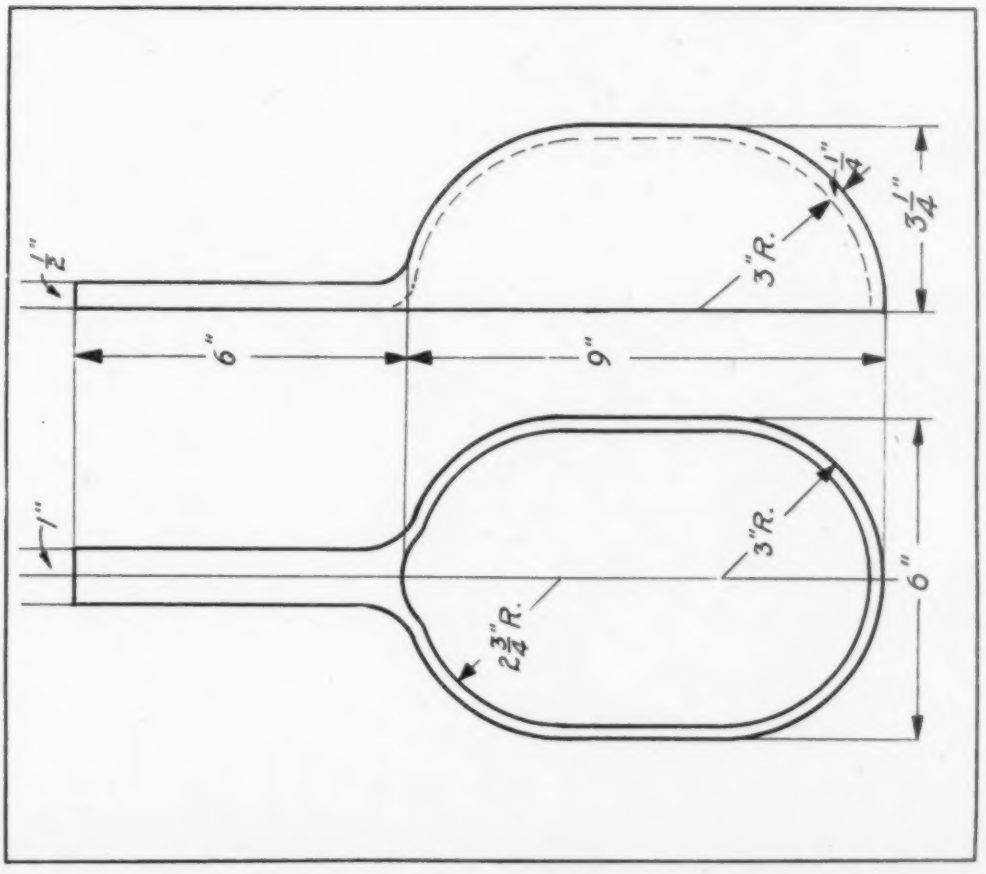
Size A	B	C	D	E	F	G	H	J	K	L	Wt. Lbs.
3"	1½"	2"	1½"	6"	1½"	¼"	1"	½"	1"	3½"	3¾"
4"	1¾"	2⅜"	1¾"	7½"	1¾"	⅜"	1¼"	½"	1½"	3⅞"	7¼"
5"	2"	2¼"	2"	9"	2"	½"	1⅜"	½"	1¾"	4¼"	12"
6"	2¼"	2½"	2¼"	10½"	2¼"	⅝"	1½"	½"	2"	4⅝"	17¾"

Weight of Cast Steel = .283 Lbs. Per Sq. Inch

DETAILS OF CAST STEEL FLASK CLAMP

THE FOUNDRY DATA SHEET No. 380, MAY 1, 1921

DIPPER FOR SAMPLING STEEL OR IRON



DETAILS OF CAST STEEL DIPPER

THE FOUNDRY DATA SHEET No. 379, MAY 1, 1921

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Propellers Cast in British Shop—I

Physical Properties of Several Bronzes Used for Propellers Given—Details of the Pattern Equipment Including the Striking Board Illustrated and Methods of Securing the Correct Pitch Described

BY WESLEY J. LAMBERT

IT IS a matter of history that the British admiralty, following the adoption of high-tension manganese bronze by the principal shipowners of Great Britain, decided, after a series of trials, that henceforth all propellers for government service should be manufactured of manganese bronze; and at the same time introduced the admiralty specification requiring tests not hitherto attainable by the use of the older and well established admiralty gunmetal.

The high-tension bronzes—as represented by those alloys having a copper-zinc base alloyed with small percentages of other metals such as manganese, tin, iron, aluminum, nickel, etc., and commonly known as manganese bronze—constitute the series of alloys from which the majority of high class propellers are manufactured. Two other non-ferrous metals, in addition to admiralty gunmetal, are used occasionally for the founding of propellers, namely, aluminum bronze, and monel metal. The former has a copper-aluminum and the latter a copper-nickel base.

Aluminum-bronze, although rarely used, has found a certain amount of favor with some shipowners; but its use has necessarily been restricted on account of its relatively high cost and of the difficulties attending the successful founding of the metal. Monel metal is smelted direct from the ore, and has been employed in the manufacture of propellers for a limited number of ships in the United States navy.

Manganese bronze, as previously stated, is a copper-zinc alloy alloyed with varying small percentages of other metals, and therefore more truly belongs to the series of alloys called *brasses*. High-tension brass is the designation actually given in the British admiralty specification, and one must perforce admit the correctness of the nomenclature, limiting the term *bronze* as applied originally to those alloys having a copper-tin base. However, the name manganese bronze has become so established by long usage, that throughout this paper the names high-tension brass, high-tension bronze and manganese-bronze will be synonymous.

The industrial brasses may be divided conveniently into three categories, according to the microstructure of the metal, as observed on the polished and suitably etched surface of a small specimen of the alloy. These three categories, or phases, are named respectively, alpha structure, alpha + beta structure, and beta structure. In the normal condition as cast, those brasses having the alpha structure represent the weaker alloys, while the beta structure represents the alloys of the greatest tensile strength: the alpha + beta structure is associated with the alloys of an intermediate strength between those of the alpha and of the beta structures.

Viewed under a microscope with vertical illumination, a polished and etched specimen of brass of either the alpha phase or of the beta phase is seen to be homogeneous, and one can observe only the boundaries of the individual grains and the light and dark effects of the light rays reflected from the more or less acid-etched facets of these grains. On the other hand, the examination of a specimen of metal in the alpha + beta phase, not only reveals the grain boundaries, and the light and dark effects as before mentioned, but renders recognizable the fact that the grains are not homogeneous in the true sense, each facet showing the presence of two constituents, the lighter colored being the alpha and the darker the beta.

The two micrographs, Figs. 2 and 5, may tend to remove any obscurity in the foregoing paragraph. Only two micrographs are given to avoid unnecessary confusion, and it is to be noted that, so far as ships' propellers are concerned, one's interest may be confined to the two categories of the brasses thereby represented. Alloys possessing a microstructure of the alpha type are seldom,

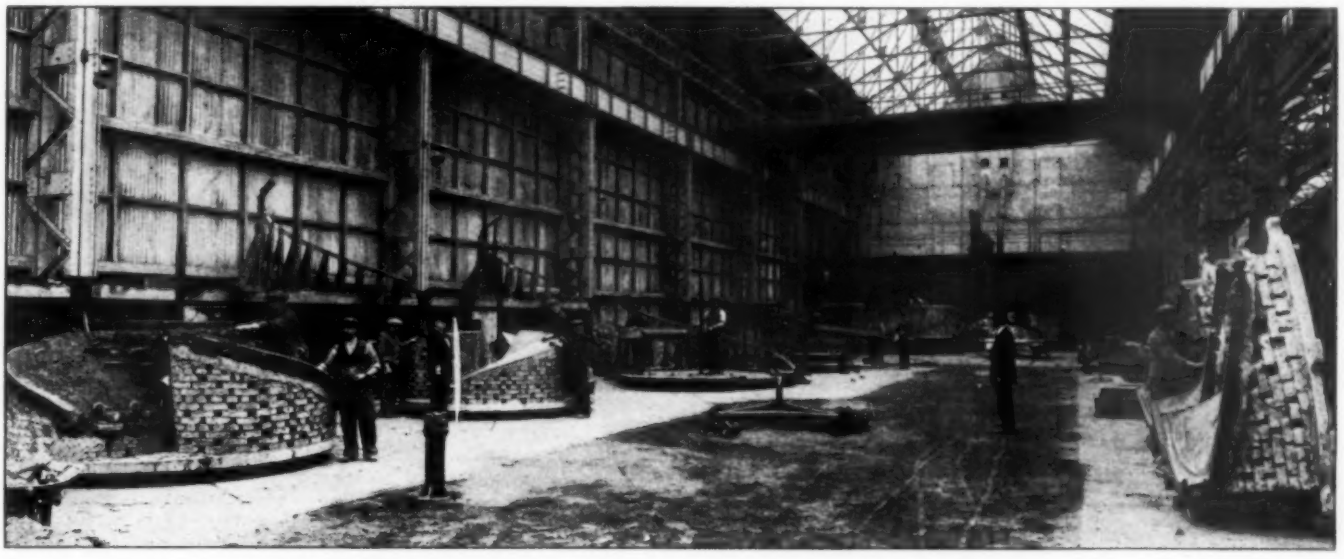


FIG. 1—THE MOLDING FLOOR IS WELL LIGHTED AND COVERED BY TRAVELING CRANES

Paper read at a recent meeting of the Institute of Marine Engineers of Great Britain, by Wesley J. Lambert.

if ever, employed in the manufacture of marine propellers.

It is obvious upon consideration of Fig. 5 that it is possible to determine by planimetric measurement the percentage ratio of the alpha constituent to the beta constituent. This ratio has a considerable bearing on the ultimate strength of the alloys within the alpha-beta range. By a computation of the percentage ratio of the two microconstituents, an estimate may be formed of the strength of any particular alloy within this range. Speaking generally, the higher the ratio of beta constituent, the greater the tenacity of the alloy. The type, the distribution and the occurrence of the two constituents, and also the size of the crystal grain, distinctly influence the strength, ductility, and resistance to shock and fatigue stresses of the alloy.

From the foregoing remarks, it will be apparent that the successful alloying

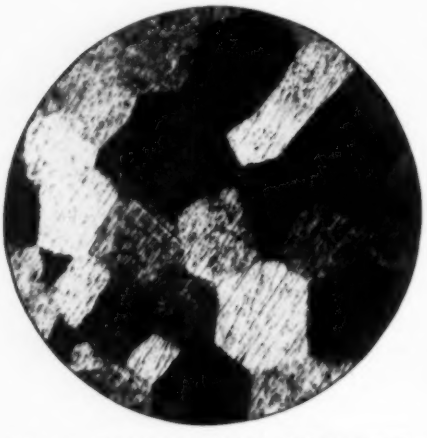


FIG. 2—HOMOGENEOUS STRUCTURE—BETA CONSTITUENT

of high-tension bronze, as used in the manufacture of a modern high-class marine propeller, can only be accomplished through the skilful and systematic examination and control by chemical and micrographical analysis. The works laboratory should include chemical, physical, and mechanical departments. Fig. 6 gives a general view of the chemical laboratory of J. Stone & Co. Ltd., London, England. The extent to which micrographic analysis is employed in the routine examination of alloys is indicated by the statement that the laboratory apparatus includes two complete photomicrographic equipments.

The recently erected propeller department at the Charlton Works, includes the drafting room, pattern shop, store room, foundry, cleaning room and machine and finishing shops. Solid propellers in high-tension bronze weighing 30 tons apiece, as cast, can be manufactured without difficulty. The furnace, drying oven, machine and crane

FIG. 3—BLADES AND THE BOSS, OR HUB OF A PROPELLER CAST IN SECTIONS

capacity is designed to deal efficiently with work of this tonnage.

It has not been found practicable to adopt any one standard bronze to meet the requirements called for by the several classes of propeller driven ships. The high-speed direct-driven propeller, with wide blades and thin edges, requires an exceedingly stiff metal, even at the risk of probable breakage by shock. However, for small tramp steamers, with low-speed reciprocating engines, a ductile bronze is preferred for the propellers, as such a metal is difficult to fracture and if bent can be easily straightened.

The character of the principal types of manganese bronze employed by J. Stone & Co. Ltd., in the manufacture of solid propellers and blades in shown in Table I.

The following notes dealing with the manufacture of marine propellers in high-tensile bronze, although, in general, applicable to other alloys than manganese bronze, have been written as particularly representing the practice when the latter metal is used exclusively. It must be emphasized, however, that in addition to strict attention to the details at every stage in the manufacture of a high-class marine propeller, a successful production, worthy to rightly challenge

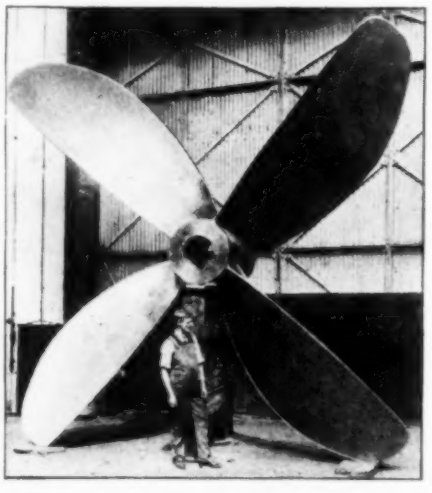


FIG. 4—LARGE PROPELLER CAST IN ONE PIECE

comparison with any engineering product of modern times, is only to be obtained by a judicious selection of carefully trained and skilled workmen aided by alert supervisors having a comprehensive knowledge of the foundry problems involved, and by the control of all furnace charges and melting by the metallurgist.

With rare exceptions, the customer's order to the manufacturer for a large solid propeller or loose blade is simply accompanied by a blueprint and specification. Patterns, either wood or metal, are seldom supplied for large work of this class and, owing to the cost of making such patterns, it is customary in well-equipped works to dispense with them, and to strike up the molds in loam in the manner described later. Small propellers or blades for which a wood or metal pattern has been furnished are generally molded in dry sand, in a suitable flask. This class of work closely follows the usual practice of

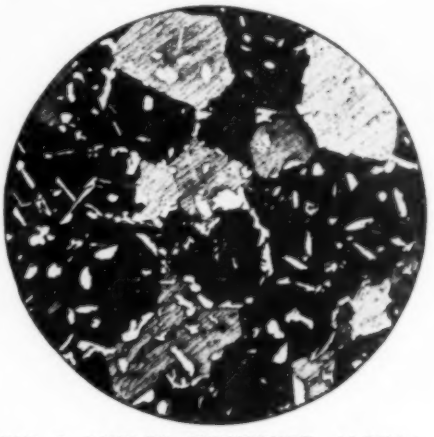


FIG. 5—DUPLEX STRUCTURE—ALPHA+BETA CONSTITUENT

pattern molding and is not discussed here.

All the necessary data for large propellers are given in the specification drawing. From these data the patternmaker can draw a full-size elevation of the blade and the boss or the blade and the flange, as the case may be; and he can construct accurately all the pieces of apparatus required.

The elevation is laid out on a suitable board, by use of a contraction rule for iron, gunmetal, or manganese bronze, which are found to require a contraction allowance of 1/10 inches to the foot. The contraction rule is not used in drawing the thicknesses of blade sections which have special allowances. This full-size elevation enables the patternmaker to test the accuracy of the main sweep, boss sweep, section pieces and pitch templates before sending them to the foundry.

The pitch piece consists of an adjustable curved construction. It has a strong wooden base, with right-angled uprights

supporting an inclined rail, usually made of teak or mahogany, the whole piece being firmly bolted together. The rail is so mounted as to correspond with the pitch, that is, its upper face traces a portion of the helical curve, at a known radius of the propeller to be manufactured. The radius of a pitch piece depends upon the diameter of the screw to be constructed, and it is advisable to have a stock of pitch pieces with various radii.

In adjusting the inclination of the rail it is necessary to use a common factor of both pitch and circumference; this factor is usually 1/6, because thus the radius cuts off a segment containing approximately a sixth part of the total circumference. Thus, if the pitch be 12 feet, the rail will rise 2 feet in moving round 1/6 of the projected circumference of the pitch piece; this inclination is adjusted by means of a set-square of a height of about 1/3 of pitch, and marked off according to the above factor. The length of the rail is usually a little more than that of the pitch piece diameter; for example, if the radius be 5 feet, the rail will extend from 10 to 12 feet, allowing ample bearing for the edges of the mold as may be noted in Fig. 9.

If a blade has a varying pitch, it can be allowed for according as the variation is from leading to following edge, or from root to tip. If the former, the line of demarcation usually lies along the center line of the blade, and this may be adjusted on the pitch piece; if the latter, a supplementary sweep board hinged to the main board at the point where variation begins, may be used, running on a supplementary pitch piece of lesser radius. Otherwise the bed of the mold must be knifed away or built up by templates to the required pitch.

The sweep shown in Fig. 8, is the piece of apparatus which generates the helicoid surface. It consists of a board to which a metal striking edge is fixed, and extends from a spindle representing the propeller axis. The board revolves around this spindle to a distance about 6 inches beyond the rail of the pitch piece; this extra length of 6 inches gives additional leverage to the mo'der. The board is suitably reinforced by a strong girder of hard wood to prevent sagging or warping, and the striking edge is notched or toothed to mark the position of the sections on the bed—notched for zinc section pieces, toothed for wooden section pieces. A bracket, fitted with a metal roller, is attached to the board, the roller running upon the rail of the pitch piece; worn rollers must never be used as they cause small but troublesome variations in pitch. The striking edge is usually 1/16 inch iron or mild-steel plate and great care must be taken to insure that it is absolutely radial to the center of the spindle. In some rare instances the center line of a blade is set off from the center of the spindle and the center line of the flange, running parallel to the radius. In such cases a wooden block of the required thickness is placed between the sweep and the arm of the bracket which works on the spindle.

The top of the sweep should be made quite parallel to the striking edge, so that a spirit level may be used when bolting the board to the bracket arm at right angles to the axis of the spindle. Sometimes a blade has a drop, that is, its center line forms an angle of less than 90 degrees with the axis of the screw, looking aft. This drop is designed to shorten the length of shaft between the propeller and the ship's contour, so that blades of large radius can work at safe distance from the curve of the stern. In such cases the sweep should have a corresponding inclination, so that a conical helicoid surface is generated. The drop of the sweep may be tested by the use of a spirit level supported on a wooden templet cut to the angle of inclination.

The special sweep for the boss is not shaped to represent the finished contour of the boss, because it would be impossible to cast such a shape without risk of unsoundness in the metal. The striking edge is wood, not metal and is fitted with a small iron tooth which cuts a groove meeting the center lines of the blade. The boss board marks out part of the head, the upper part of which is provided for by a separate cylindrical mold. It should be noted that the top of the board must always be its maximum radius.

Section pieces are made either of zinc sheet or of wood. Their dimensions are determinable from the drawing, but certain important allowances have to be made, including those for shrinkage, machining, distortion, and thin edges. The flange pattern concerns blades only. It is made of wood and resembles a segment of a solid sphere based on a thick disk. The bolt hole recesses are cut away as required and the pattern is made with due allowances for machining and shrinkage.

Pitch templates are used for correcting pitches at various radii, or for testing any variations due to cutting away or building up. They are constructed on the principle that the helical angle increases from the circumference to the center where it becomes 90 degrees. A spirit level is used to test their position on the bed of the mold. Tilt and fillet templets of wood for the correct building up of tilt, designed to facilitate the flow of water from the root face of a

FIG. 6—THE LABORATORY IS FULLY EQUIPPED FOR ANALYZING ALL MATERIALS ENTERING INTO THE CASTINGS AS WELL AS THE RESULTING ALLOYS

Table I

Physical Properties of Bronze Used for Propellers

Type of bronze	Ultimate strength pounds per square inch	Elongation, per cent in 2 inches	Microstructure
1	89,600 to 94,100	20-25	all beta
2	80,600 to 85,100	30-35	alpha beta
3	73,900 to 78,400	25-30	alpha beta
4	71,700 to 76,200	25-30	alpha beta
5	67,200 to 71,700	30-40	alpha beta

blade, or for the cutting away of fillets, where the blade meets the boss, or hub, are made to the radii of curves as given in the design print. The radii of fillet curves are least toward the edges of the blades and greatest toward the center lines.

Large propellers are always cast with cored bosses. The dimensions of the core are fixed by the patternmaker, and the sweep of wood is constructed to enable a suitable core to be struck up. Propellers of less than 5 feet in diameter are usually cast with solid bosses. The core tapers from the bottom of the mold upwards, that is, in a direction opposite to the taper of the finished shaft hole. This core is made as small as conveniently possible and tapered upwards to facilitate the flow of metal to the blades. Lightening chambers in a boss are, if possible, to be avoided, because they prevent the adequate feeding of the metal to the blades.

For molding a solid propeller a circular cast-iron molding plate 2½ to 3 inches thick, is first chosen, of a radius about six or seven inches less than that of the pitch piece to be used with it, and about four to six inches greater than the radius of the propeller. The plate is then mounted on a permanent foundation called the bed. By bolting three or four L-irons to the bed, so that the plate fits between them, the replacement of the molding plate in exactly the same relative position to the bed is easily accomplished.

All molding plates are designed so as to be quite rigid when lifted. The accuracy of pitch in a mold is seriously affected by a springing plate. Into the center of the molding plate is screwed a steel spindle furnished with a strong metal bracket arm to carry the sweep as well as a strong metal ring or collar fitted with a securing screw to hold the boss board, and a revolving cap, complete with pulley wheel, cable and balance weights to support the weight of the sweep shown in Fig. 8.

The sweep is bolted to the spindle arm so that the leading or forward side of the striking edge is exactly radial to the axis of the spindle. The sweep is then adjusted with a spirit level to assure of its being quite horizontal, or at whatever angle the drop requires.

Find Center Line of Blades

A suitable iron spike is then screwed point downward to the end of the sweep, and a circle is traced with it on the floor plate which has been chalked over for the purpose. The circle is carefully divided into three or four parts, according to the number of blades, using a large pair of compasses. The radii extending to these points are plainly marked on the upper surface of the molding plate and on its edges. These indicate the center lines of the blades. The spike is then removed.

The pitch piece is fitted round the molding plate at the known radius, and the roller of the sweep is adjusted to run centrally on the rail, while the center point of the pitch piece, distinctly marked in the pattern shop is so placed as to meet the extended radius of the center line of a blade. The pitch piece is then clamped or securely weighted to the floor.

A fore-and-aft projection of a blade is now outlined on the plate, round one of the center lines. This is done by using strips of wood cut to the half length of sections. These are held from the striking edge to a set square placed on the center line and marked to the height of the bed mold. A plumb line hung from the striking edge gives the projected outline on the bed plate. The edges of the mold are allowed four to seven inches around the blade projection, and this final outline is marked with chalk. Ample allowance is thereby afforded for the seating of the cope, and for the overlapping of wide blades. The final mold area is templeted with iron rods so that the remaining blades can be easily marked out.

The actual building of the mold follows the usual practice of brick and loam molding. The bed molds of the

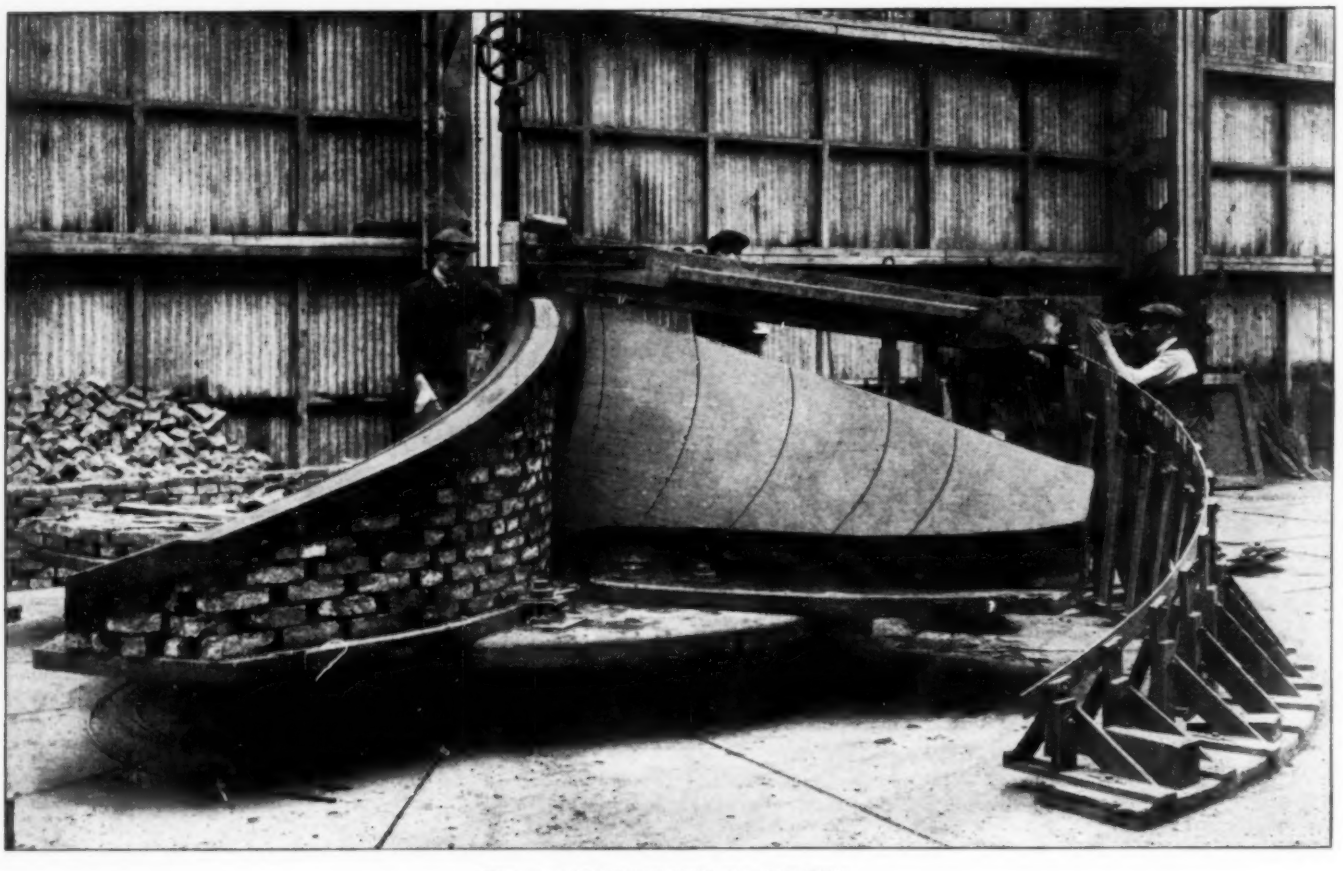


FIG. 7—MOLDING THE BLADE BED

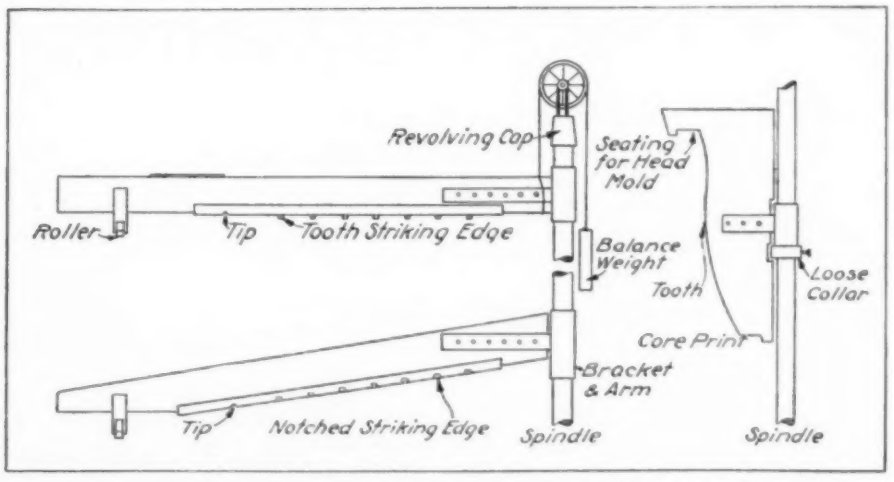


FIG. 8—TYPICAL SWEEPS, TO THE LEFT—BOSS BOARD, TO THE RIGHT

blades are built up successively, moving the pitch piece as required. The bricks should not be closely packed, but left fairly open so that the loam may dry more quickly. The nature of the loam is an important point. Its behavior depends largely upon the amount of clay constituent in the sand from which it is made. The loam must be kept as open and porous as possible. The blade molds are thus built and roughly struck up with loam facing, provision being made both for the runner and the necessary test bars.

The runner is molded in loam also, a piece of gas barrel being used as a pattern. A stock of tubes of varying lengths and diameters, covering a range suitable for the largest to the smallest propeller, is held in the charge of the foundry storekeeper. The runner lies horizontally below one of the blades, opening on the bottom of the boss, while allowing ample room for the core-print. Its vertical portion is built up outside the mold, and it is provided with a suitable dirt trap. The mold of the boss is roughly shaped with a hard-wood templet.

The mold is then removed to an oven where it remains until sufficiently dry for proceeding with the second course It is important to control the temperature of the drying ovens. If the heat be too high the surface of the wet loam hardens rapidly into a crust which must crack excessively to permit the steam from the moist loam beneath to escape from the mold. The first drying, while it should be thorough, is of less extreme heat than the second or third drying. It is found economical in foundries which contain two or more ovens to use one of them for moderate drying, and the other for higher temperatures.

Generally the mold is withdrawn from the oven after one night of drying but sometimes two nights are allowed for very heavy molds. The mold is then replaced exactly in its original position on the floor plate, and the pitch piece is adjusted. The surface of the mold will be found to have cracked and expanded in drying. To eliminate this the sweep is swung over the surfaces of the mold until the roller of the board runs evenly on the rail of the pitch piece. Thus a helical incline is produced, true to pitch. The correctness of this pitch must be tested by pitch templets before any further building is proceeded with.

The section pieces are now fixed in their positions, the point where they intersect the center line being marked on each of them . They are secured vertically by nails or wooden brackets. Pieces of wood cut to the casting thickness of tip are fixed against the tip section. The outline of each blade is now marked out round the extremities of the section pieces.

The blade pattern thus formed by the section pieces is filled in with bricks and dry sand, slightly rammed and finished off with smoothing trowels. Sometimes the pattern is lightly brushed with water to harden its surface, and then the whole is freely sprinkled with powdered plumbago or parting sand.

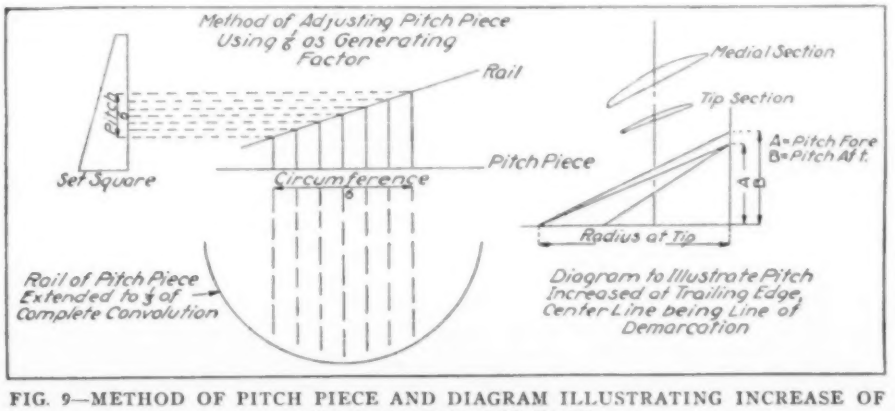

Method of Adjusting Pitch Piece Using ⅛ as Generating Factor
Rail
Pitch
Set Square
Circumference
Pitch Piece
Medial Section
Tip Section
A=Pitch Fore
B=Pitch Aft
Radius at Tip
Rail of Pitch Piece Extended to ⅛ of Complete Convolution
Diagram to Illustrate Pitch Increased at Trailing Edge, Center Line being Line of Demarcation

FIG. 9—METHOD OF PITCH PIECE AND DIAGRAM ILLUSTRATING INCREASE OF PITCH AT TRAILING EDGE

Joins Mid-Western Force

S. N. Clemons, for the last seven years assistant purchasing agent of the Northway Motor & Mfg. Co., recently resigned to become identified with the Mid-Western Sales Corp., 209 Chalmers building, Detroit, as general sales manager. Mr. Clemons, through his long association with the automotive industry, is widely known. The Mid-Western corporation will handle a line of nuts and bolts, piston rings, screw machine parts, forgings and castings.

Spanish Firm Orders Large Annealing Furnace

The Electric Furnace Construction Co., 908 Chestnut street, Philadelphia, has secured an order from the Sociedad Espanola De Construccion Naval, Madrid, Spain, for a new design of electrically heated car type annealing furnace for heat treatment of large steel ingots and forgings.

The furnace, it is said, will be the largest electric furnace yet constructed for this particular class of work. It will be designed to heat a charge of 60 tons of steel to 1700 degrees Fahr. every 24 hours.

Commence Construction of Pump Plant

A new foundry has been started at Ville la Salle, near Montreal, Canada, where castings will be made for the manufacture of oil fuel pressure pumps, transfer pumps, service pumps, for ballast and fresh water, turbine driven circulating pumps, air pumps, feed pumps, etc. This plant is being built by G. and J. Weir, Ltd., a firm incorporated in Canada. For the past twenty-five years, pumps of this make have been imported from Scotland, and since 1918, a Canadian subsidiary has imported the parts and assembled them on this side of the water. It is planned to employ about 50 molders to furnish the castings formerly made abroad.

Yellow Scrap Is Useful In Foundry

The Exceedingly High Quality and Purity of Copper-Zinc Alloys Which Have Been Subjected to the Cold Rolling Process Renders the Metal of Peculiar Value to the Brass Founder

BY R. R. CLARKE

COLD-ROLLED yellow brass, in such forms as rods, tubes, pipe, sheets, etc., is composed of high grade copper and zinc, perfectly alloyed. The fracture indicates a metal superior to ordinary yellow casting brass. A considerable quantity of this scrap generally is on the market at a favorable price. The principal objections to its use lie in the difficulty in handling it in purchased form and in the high melting loss. Its use involves slow furnace charging, high melting loss and a rather high zinc content. To reduce the zinc would necessitate addition of copper and a corresponding increase in cost so that all in all its merits are doubtful when used for straight yellow brass work.

However, conditions do exist where scrap can be used to advantage. It is made from high grade virgin metals, is remarkably homogeneous and free from impurities such as oxide, dross, etc. The advantages of such a concentrate are obvious in formulating common alloys like the following: Copper 86, zinc 14; copper 87, tin 8, zinc 5; copper 88, tin 10, zinc 2; copper 85, tin 5, lead 5, zinc 5; copper 86, tin 3½, lead 3½, zinc 7.

Better Alloy from Yellow Metal

The use of yellow scrap results in a better alloy at a reduced cost. In any copper-base alloy containing zinc the prevailing practice is to melt the copper and later add the zinc along with other elements as required. In adding the zinc a considerable portion is lost by volatilization. This loss increases if it is necessary to raise the alloy to a higher temperature for casting purposes. Castings poured at this temperature in fairly high zinc alloys present a *rat-tail* or *smoky* appearance due to zinc oxide. Now if instead of using virgin zinc, the copper-zinc concentrate is utilized, these objectionable features are eliminated. The castings are smoother on the suface, the metal much improved and the loss from volatilization considerably reduced. Alloying copper with zinc requires considerable stirring to insure uniform distribution. This particularly is the case if the zinc be added in large quantities. In using the concentrate, the metal rapidly disappears in the copper mass with no flaring or spitting, just a slight bluish green flame and a natural mixing and readily incorporates with little stirring.

Ratio of component parts in the material is copper 60, zinc 40; or 3 to 2. With the two elements at 20 and 11 cents a pound respectively the value of their equivalents in new metals is 16¼ cents per pound. The yellow scrap can be obtained at nominally 14 cents, a saving of 2¼ cents per pound. In alloys such as copper 86, zinc 14; copper 86, tin 3½, lead 3½, zinc 7; copper 87, tin 8, zinc 5; and copper 85, tin 5, lead 5, zinc 5, the substitution of the concentrate would approximate a 35-pound, 17½-pound and 12½-pound virgin metal displacement respectively and these multiplied by the differential in price would mean a corresponding saving of 79, 39 and 28 cents per every 100 pounds of metal melted.

Resorting to the concentrate involves practice approximately the same as in the new metals. The copper first is melted fairly hot, the tin and lead introduced and finally the yellow scrap which, of course, can be manipulated in either loose or cabbaged form. The furnace then is closed and the metal brought to pouring temperature. In estimating the quantity of scrap necessary, two points must be borne in mind. A sufficient quantity of scrap to furnish the zinc required and to reduce the copper properly must be included. Thus in brazing metal analyzing copper 86, zinc 14, the percentage of scrap is that required to furnish 14 pounds of zinc to the 100 pounds aggregate and arises from the division of 40 into 14 which, of course, is 35 per cent. This amount of scrap contains 60 per cent copper or 21 pounds; so that the formula must read copper 65, yellow scrap 35, and will then approximate copper 86, zinc 14. For the following alloys, copper 86, tin 3½, lead 3½, zinc 7; copper 87, tin 8, zinc 5; copper 85, tin 5, lead 5, zinc 5; and copper 88, tin 10, zinc 2, the formulas are respectively as follows: Copper 75½, tin 3½, yellow scrap 17½; copper 79½, tin 8, yellow scrap 12½; copper 77½, tin 5, lead 5, yellow scrap 12½; and copper 85, tin 10, yellow scrap 5. In each case the copper displacement is considerable while that of zinc always is substantially that indicated by the formula. Regarding its use in the higher zinc alloys, manganese bronze, tobin bronze, etc., there is little doubt but that scrap would prove satisfactory as to quality. In these cases, however, the total zinc content in the scrap is little, if any, higher than the requirements of the alloy so that the great bulk of the charge necessarily would be scrap alone and entail in the melting the difficulties already referred to.

In using the scrap for the purposes outlined, two important points must not be overlooked. First it must be remembered that the 60-40 ratio is only approximate and may vary slightly from the actual figures. It therefore is evident that in making up alloys that must meet close specifications, there always is the possibility of miscalculation. Practically no variation in physical property would result, yet a slight change in the appearance of the casting might arouse suspicion of an altered composition. The second point is the possibility of buying apparently similar scrap which contains low percentages of aluminum and of confusing it with the genuine copper-zinc materials.

Melt at Low Temperature

There is still another use to which yellow scrap is peculiarly adapted. In melting any zinc alloy there always is a risk of attaining a dangerously high temperature in the furnaces. This is especially true in air and oil furnaces and frequently results in porous castings. In all such cases it can be assumed that the zinc content in the alloy has been considerably lowered by the high temperature. The natural thing to do is to cool the metal to a correct pouring temperature which is in itself a safeguard against porosity. Now if instead of using gates or metal similar in composition to the alloy we resort to this yellow scrap for *cooling down*, three points of advantage result: A correct temperature is assured; lost zinc is recuperated and greater assurance of metal quality exists, since one of the functions of zinc is to eliminate the oxides and gases occasioned by superheating. The objection might be made that in an excessively superheated metal the amount of scrap required to cool it would involve an unreasonable amount of re-introduced zinc.

In the first place there can be no good excuse for such an excessive temperature, and even though there was, it can be safely considered that as the temperature rises beyond a normal limit, zinc escapes in increased quantities so that the amount of a 60-40 copper zinc metal required to reduce an excessive temperature in the average alloy will come close to balancing conditions regardless of the temperature degree or the metal necessary to reduce it.

How and Why in Brass Founding

By Charles Vickers

Miscellaneous Mixtures for Motor Parts

We would like to obtain mixtures of metals to be used in the fabrication of electric apparatus and motors in sizes from ¼ to 300 horsepower. The mixtures we desire for the following purposes:

1. *Bronze for motor slip rings.*
2. *Bearing bronze for motors.*
3. *Bronze for worn gearing under severe conditions.*
4. *Bronze for machinery parts, 2 alloys; one for great strength, one for strength and resistance to great shock.*
5. *Common machinery bronze, a steam metal with good casting and machining properties.*
6. *Cheap mixture for castings for tram car fittings.*
7. *Copper mixture for castings with high electrical conductivity.*
8. *Mixture for apparatus parts exposed to electric arcing.*

In addition to the formulas we desire suggestions as to the proper method of manufacture, fluxing and so forth, also their average tensile properties, yield point, elongation and Brinell hardness, also method of making test bars.

We suggest the following alloys: For No. 1 copper 86.50 per cent; tin, 7.50 per cent; zinc 3.50 per cent; Lead, 2.50 per cent.

For No. 2 copper 75 per cent; tin 10 per cent; lead 15 per cent.

For No. 3: Copper 87 per cent; phosphor copper 2 per cent; tin 11 per cent.

For No. 4: Strong alloy; copper 90 per cent; tin 5 per cent, phosphor tin 5 per cent. For machinery parts, copper 88 per cent; tin 10 per cent, zinc 2 per cent. For strength and great resistance to shock, copper 88 per cent; iron 2 per cent; aluminum 10 per cent.

For No. 5: Copper 85 per cent; zinc 5 per cent; lead 5 per cent.

For No. 6: Copper 86 per cent; tin 3 per cent; zinc 8.50 per cent; lead 2.50 per cent.

For No. 7: Pure copper 100 pounds; silicon copper 1 pound.

For No. 8: Copper 94 per cent; tin 4 per cent; phosphor tin 2 per cent.

For methods of making test bars see the August, 1917 issue of *The Foundry*, page 322.

The average tensile strength of these alloys will run from 30,000 to 40,000 pounds, and elongation from 15 per cent upwards depending on the alloy and the care with which it is made. In the case of the aluminum bronze, the average tensile strength will be 70,000 pounds per square inch, with an elongation of 20 per cent.

Manifold Castings Made of Aluminum Alloy

We have received an inquiry for exhaust manifold castings of aluminum alloy, and we desire to ascertain if there is an alloy of aluminum suitable for this purpose. If there is, would such an alloy be practical for sand castings?

An alloy containing 9.50 per cent copper, and 90.50 per cent of aluminum frequently is used for casting manifolds for internal combustion engines. Such an alloy is simple to make. First melt any quantity of copper, for example 25 pounds, under charcoal, and add a little at a time 25 pounds aluminum, which makes a "hardener" known as 50-50 copper-aluminum.

Melt together 19 pounds of the above hardener and 81 pounds of aluminum, or any quantity in that proportion. Pour the castings as cool as it is possible to get them to run.

Tumbling Brass Castings

We would like a mixture to use for rumbling 2-inch brass nuts. We are at present using a mixture of one pail coarse gravel, one pail of fine gravel, and from 6 to 8 pounds of washing soda. It requires 4 days rumbling with this mixture and we would like to cut down on this time, if possible.

The object of this long rumbling is, we suppose, to polish the nuts. Why not try the more modern method of tumbling, with steel bicycle balls. The larger the castings, the larger the balls that can be used, though they should be mixed with smaller balls. It will be necessary to use a liberal supply of the balls, the more balls the greater rapidity of the operation. Ordinary plain work can be polished in 15 minutes with plenty of balls. The tumbling barrel should run horizontally and be almost submerged in a wooden tank filled with a soap solution. The tumbling barrel is best made hexagonal and should be of hard wood, preferably brass lined. It is fitted with a screen door so the solution can come into contact with the work. The barrel should be filled about half full of balls and castings. The balls are what are known as *seconds*, and those most generally used for this purpose are ⅛ inch diameter, and of course are made of hardened steel. The barrel is revolved at a speed of about 50 revolutions per minute, and the time will be cut from 4 days to at the most an hour or so. The soapy water can be used many times over, and the balls indefinitely.

Cast Bronze Name Plates

We wish to make cast bronze name plates and would like to get neater letters and figures than those ordinarily used for pattern numbers and letters, and wish to know the usual procedure for making patterns for cast bronze name plates.

The usual method of making name plate patterns is to make first a wooden pattern of the background of the plate, with a raised border; then to attach the letters and numbers with shellac.

As a roughened background looks better than a smooth one, this effect frequently is produced by indenting the wood pattern with a small punch before the letters are attached. Another way is to shellac a rather coarse cloth on the name plate, attaching it firmly to the wooden background, then shellacing it so it will leave the sand. Then the pattern letters are shellaced to this cloth background. A name plate pattern also

may be modeled from plastic modeling clay. In this case, the clay is attached to a board, such as a drawing board, and the entire name plate, letters and all ornamentation is modeled. A skilled modeler can produce unique effects by exercising his imagination in making such patterns. The plastic clay can be molded directly, and a white metal pattern made, which when chased and fitted, makes a master pattern from which brass patterns can be cast. The letters and numbers used with wooden patterns, can be obtained in a variety of styles from manufacturers of pattern letters.

Attaching Letters to Iron and Aluminum

We wish to get information regarding the best methods of attaching pattern letters to iron and aluminum patterns. We have tried several ways, but have not met with any great amount of success. Also how can bosses and other additional parts be fastened to patterns of aluminum without the aid of screws or dowell pin? We know there is a method of soldering these on, but are not familiar with the process.

Pattern letters and numbers generally are attached in their places by strong shellac. The surface of the pattern, whether iron or aluminum has to be filed or scraped smooth before the shellac is applied. Letters also frequently are fastened to wooden patterns by small nails. In the case of iron patterns, brass letters can be used and these are easily soldered to the patterns. If shellac has failed to hold the letters on aluminum patterns, a mixture of half shellac varnish and rubber cement may be tried. The most satisfactory manner of putting letters and numbers on aluminum patterns is to cast them in place.

Bosses and other parts can be soldered to aluminum. No acid or other flux is necessary. The soldering can be done with pure tin. The aluminum should be cleaned and smoothed, heated to the melting point of the tin, then the latter should be coated on the aluminum by rubbing, using an aluminum soldering tool, not a copper one. The rubbing is necessary to scratch away the film from the aluminum surfaces, because this film prevents the solder from adhering. After the parts to be joined have been tinned in this manner, they can be sweated together. In place of tin, aluminum solders may be used. There are many of these available, and it is better to purchase them than to attempt to make them.

Melting Monel Metal

We are contemplating casting Monel metal and would like to have information about the fluxing agents to use. We intend to melt the metal in pit-type furnaces. Any information you may be able to give in regard to the melting, fluxing and deoxidizing of this metal will be appreciated greatly.

As Monel metal requres a higher temperature to melt it than bronze, the most important point is to have a furnace capable of reaching this temperature, and it should do this with a reasonable amount of speed; otherwise, the metal will have to soak in the fire so long it will be spoiled, and no fluxing agents will produce good castings.

Some melters prefer a flux of two parts fluorspar and one part lime mixed, using 2 per cent in melting. It is essential to melt the metal quckly, and because of this, solid fuel furnaces are not as satisfactory as gas or oil-fired furnaces in making castings of this metal. Electric furnaces also are suitable for the purpose. Magnesium can be used as the deoxidizing agent, though the writer personally prefers deoxidizers suitable for producing copper castings, of high electrical conductivity, a number of which are on the market. For making the molds, use a sand of high fusing point, such as silica sand for a facing and mix it in a manner similar to a steel facing, that is, with China clay and molasses to give the proper bond. The molds will be more successful if they are dried.

Protecting Cores from Phosphor Bronze

We have had considerable difficulty of late with our core sand, due to the metal casting into the cores set in heavy castings. Is there any mixture of core sand that will prevent this condition?

The alloy being used probably is phosphor bronze, or phosphorized metal. Such alloys are penetrating and soak into a core in a manner similar to water, though not of course in the same degree. A good core must possess permeability in a comparatively high degree. This property permits the gases to escape readily and the metal follows the gases, producing the condition mentioned. If the core is made dense in structure, by using fine sand mixed with the coarse, then it will blow. The alternative is to put a coating on the outside of the core that has no pores into which the metal can seep. Plumbago is the material generally used by foundrymen, but it will have to be thicker than the usual *wash*. If plumbago is used, give the core a coat and dry it as usual, then rub the surface with a *paste* made of plumbago and molasses water, and polish it. The steel founder uses a creamy wash of silica flour and some adhesive to coat his cores, but silica flour has been known to produce spongy phosphor bronze castings. Try a coating of the best plumbago the supply houses can give, and mix with dilute silicate of soda, instead of the cheap molasses carrying sulphur dioxide. If this fails to work, get aluminum cement, dilute with water to a cream and apply.

Propeller Blades Break in Service

We lately have encountered a rather peculiar difficulty with manganese bronze propellers. We have been casting wheels from 26 to 44 inches diameter, with 3 blades. One of these we have been called upon to replace twice on account of a blade breaking off, although the vessel owners contend the propeller has struck no obstruction during its voyage through the Panama canal. We have tried to break off the remaining blades on this wheel, but were unable to do so either hot or cold; we could only bend them. We would like your suggestions as to the cause or this difficulty.

In view of the fact the remaining blades bent but did not break it would appear there can be no criticism of the metal. This brings out a question. Was there any hidden defect in the root of the blade which broke off? Such defect might have assumed the form of a fine hair crack. Study whether the location of the risers on these castings favors two blades at the expense of the other. Assuming there was no defect consider whether it is possible for a blow to have broken off the blade, instead of bending it. With a manganese bronze of high elongation it seems improbable that a blow would have any other effect than to bend the blade. A careful investigation of the break would show if dross was present at that point even if the break was smoothed over by water erosion. We are unable to do more than offer suggestions as to the possible causes of the break and not being in a position to scrutinize the broken casting and watch the process of making similiar castings, this is largely guesswork. The truth can only be found by a careful study of all the factors in the case.

Rigging for Speed in Blower Work

Precision Requirements Met by Molding Equipment Combining Accuracy with Quick Operation—Peculiar Problems Solved in Casting Turbine Rotor

BY HERBERT R. SIMONDS

WHENEVER any one machine part is to be made over and over again, its production immediately introduces problems which are not present in small quantity work. These problems in connection with quantity production have been largely responsible for the advance in foundry practice in this country. An example of efficient repetition work in connection with the production of equipment which depends for its success on precision is noted at the foundry of the Coppus Engineering & Equipment Co., Worcester, Mass.

This company makes power plant specialties of various kinds but its chief product is the forced draft blower shown in Fig. 1, which consists essentially of a steam turbine runner and a fan mounted on one shaft with the proper housing, and attachments. Almost all of the parts, including the casings, the fan, and the turbine runner, are made in a modern foundry which has just been completed within the past year. The fan blades were molded by hand at first, and a good molder, in a full day would turn out six complete molds.

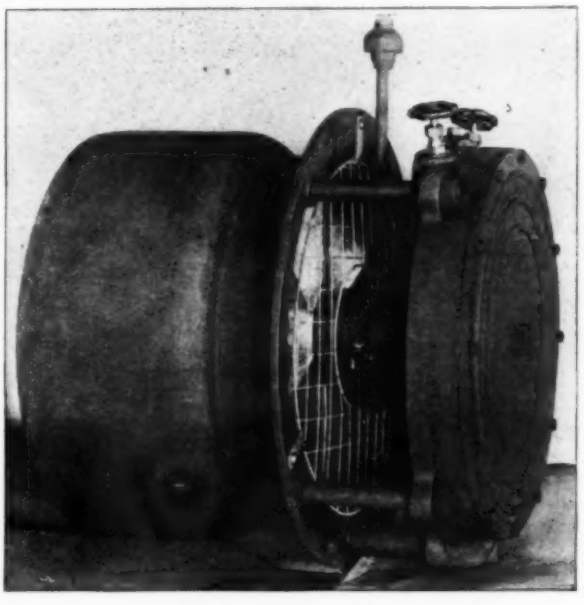


FIG. 1.—CASTINGS FOR THIS COMPACT UNIT FORM THE PRINCIPAL PRODUCT OF THE FOUNDRY

The construction of the particular fan in question does not readily lend itself to the use of a match plate and for this reason hand production of molds was allowed to continue longer than it otherwise would have been. Last fall, a new superintendent was placed in charge of the plant and the question of fan blade construction soon came under his attention. He felt that match plates could be made and that much time could be saved through this method of molding. Consequently he set to work to make a plate in the regular way. A perfect mold was made and the halves separated a ¼-inch by strips. A casting then was made, but it was found that while separating the mold ¼-inch gave approximately ¼ inch thickness of metal on the fan blades which are relatively flat with respect to the mold, it gave scarcely any thickness to the metal on the nearly vertical surfaces between the blades. In fact, the design of the six blade fan is such that in drawing the pattern the lower edge of one blade will barely pass the upper edge of the adjacent blade. To overcome this, thin copper plates were fastened on the match plate to form the vertical surfaces between the blades which could not be cast in the usual manner. Having once secured perfect match plates, the next question was to facilitate their use so as to gain the maximum benefit.

A special molding machine was constructed as shown in Figs. 2 and 3. The plate with the two halves of the pattern was mounted in a frame in such a way that it could be replaced with other plates when different designs were desired. The frame, as shown in the illustration, is swung between two solid cast iron brackets extending up from a concrete base in the floor of the foundry. Thus mounted, the plate with this frame is free to revolve about a horizontal axis. At one bearing, the one shown at *A* in Fig. 2, a hole was cut through on the top of the journal box and a pin inserted fastened at its upper end to a strip of spring steel as shown. This pin, through the spring action of the strip, presses on the shaft of the frame. Holes were drilled in the shaft at points directly under the pin, so that when the plate is in a horizontal position, the pin drops into a hole and holds the rotating frame and pattern plate firmly on the machine.

Approaching the machine from the front, a track was built to provide for a small car used in handling the flask before and after molding. Directly below the pattern and concentrically with it in its position in the frame, a pneumatic cylinder was embedded in the floor of the foundry in such a way as to operate a level plate up and down as desired. The plate is shown in the illustration, raised some 6 or 8 inches off the floor. In molding, the operation is briefly as follows:

The pattern plate is swung into position with that side of the pattern uppermost which it is desired to mold. Consider, first the cope. With the cope half of the pattern in position, the cope flask, shown at *B*, Fig. 2, is set on in the reverse of the position which is shown. The cope flask is liberally barred with perforated plates, which serve to support the sand forming the face of each blade and provision is made for the hub core. With the flask set and clamped to the pattern plate, sand is tucked in about the blade portions, and rammed. A special sand mixture composed largely of No. 1 Albany is used.

When the mold is rammed, it is swept level with the lower edges of the flask and then the pattern plate frame with the completed cope mold firmly clamped in place is swung on its axis through 180 degrees. The cope now hangs suspended beneath the plate.

When in this position, a small cart with a hole in the center of its platform large enough to pass the small circular plate of the pneumatic cylinder through it, is moved into position under the completed cope. The small circular plate which, as has been described, is adapted to be pneumatically raised or lowered, is then raised up through the opening of the cart platform. A square board or skid as large as the outside diameter of the flask is then placed on this circular plate and the two are brought gradually up by the air cylinder to press firmly against the lower surface of the cope. While

FIG. 2.—ALUMINUM FANS ARE MOLDED BY THE AID OF A SPECIAL MOLDING MACHINE

in this position, the clamps holding the cope to the pattern-plate frame are loosened and a pneumatic vibrator fastened to the side of the frame is started.

The plate of the pneumatic piston is then lowered gradually, and as it passes through the opening in the cart, it leaves the skid and the finished cope on top of the cart which is then ready to be rolled away. This operation is better understood through an examination of Figures 2 and 3. In Fig. 3, the cope has just been lowered onto the cart, and is ready to be rolled back out of the way. The skid supporting the cope is clearly seen. The car with the skid, *C*, and the completed cope is shown in Fig. 2.

At *D* in Fig 3 is the drag which has already been completed. The molding

FIG. 3.—THE MOLD IS CAREFULLY LOWERED BY PNEUMATIC PISTON ONTO A SMALL CART

of the drag is exactly the same as that of the cope except the opposite side of the match plate is used and the flask is of course without the perforated bars.

The inside of the hub is cored out by a cylindrical core which is shown in place in the illustration. When both the drag and cope have been completed, and the core has been set in place, a fine parting sand is used to dry the sand surface and then surplus particles are blown off by an air hose. The mold is then closed, and clamped and is ready for pouring.

The use of this equipment not only insures more accurate work but it has increased the production greatly. At present, one man using the machine is able to complete 20 molds a day. In the design of a machine of this sort, it is necessary to watch carefully two or three points. It is important that the travel of the pneumatic piston and the horizontal plate which it carries shall be at right angles to the plane of the match plate. The action in drawing the mold away from the match plate must be smooth and accurate and the match plate in this horizontal position must be held rigidly.

Because of the thin surfaces which extend a considerable distance from the gate, it is important that the metal be as hot as possible, and be uniform in quality. The fans are cast of an aluminum mixture, consisting of 3 per cent copper, 14 per cent zinc, and 83 per cent ingot aluminum. This is melted in a tilting crucible furnace which has a 125 pound capacity per charge, and which is oil fired and controlled by pyrometers. Six of these furnaces made by the Monarch Engineering & Mfg. Co., Baltimore, are permanently mounted in a row at one end of the foundry. Two of these in operation are shown in Fig. 4, and in Fig. 5, one furnace is shown pouring. The complete fan blade casting weighs about 12 pounds, but as it is necessary to have a heavy riser to guard against uneven shrinkage, the amount of hot metal used for each mold is 20 pounds.

The metal is heated carefully to a temperature of 1500 degrees Fahr. which is so close to the critical point that it is necessary to have the furnace carefully watched to prevent burning. To reduce the cooling effect to a minimum, the ladles used in carrying the hot metal to the molds are preheated with a special ladle oil heater. After the metal has been poured, the flasks are opened and the castings shaken out. Fig. 6 shows these castings just after they have been taken out of the molds. From

FIG. 5.—LADLES ARE PRE-HEATED BEFORE RECEIVING THE CHARGE

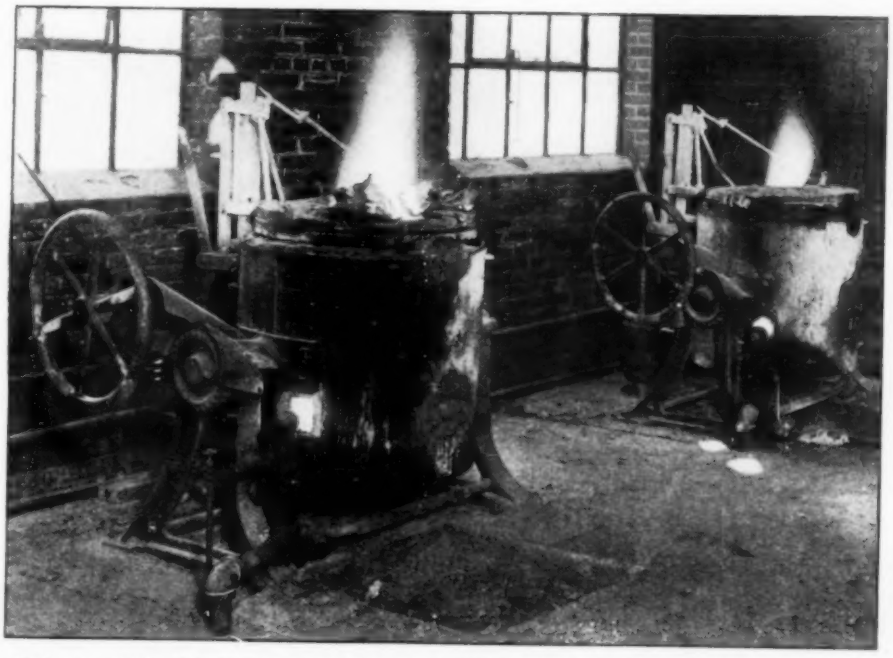


FIG. 4.—TWO OF A ROW OF SIX TIPPING FURNACES USED FOR MELTING

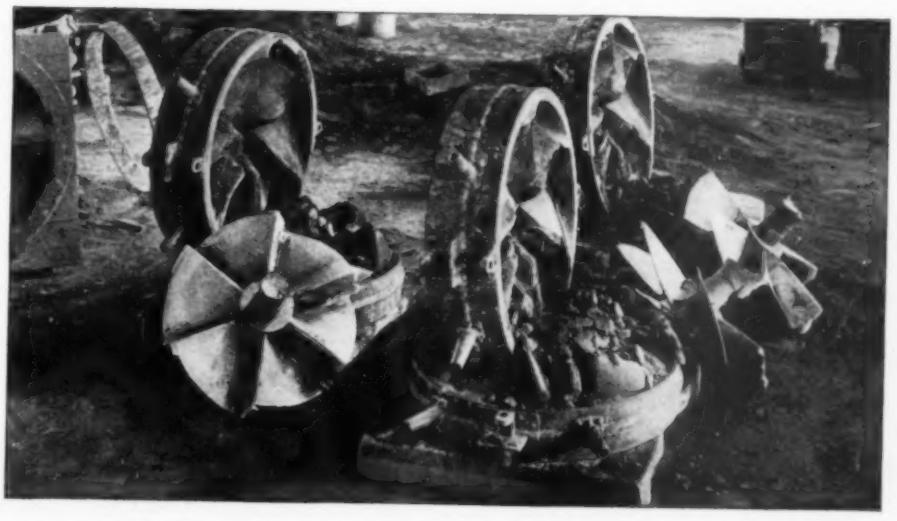


FIG. 6.—THE FANS HAVE A SMOOTH BLADE SURFACE WHEN THEY ARE TAKEN FROM THE MOLDS

FIG. 7.—THE EXTRA METAL OF THE RISERS IS CUT OFF BY HAND

here they go to band saws where the gates are sawed off, and later to a sand blasting room. Fig. 7 shows this operation. The saws used are standard band saws and the operation is quick and simple. In the foreground of Fig 7 some of the casings used in the blower are shown. These are cast iron and are made in one end of the foundry which is devoted to iron work. The cupola for this department is located outside of the foundry proper with the spout extending through the wall of the foundry.

At *E*, Fig. 8 is shown the turbine runner casting as it comes from the mold. Producing this casting constitutes an interesting foundry job. The main portion of the runner is cast bronze, but the buckets which are shown in a double row surrounding the runner are of a special noncorrosive alloy which is drawn to shape and cut. The problem has been to produce a firm bond between the bronze and these small alloy buckets, which, because of the design of the runner, must be set extremely close together. The turbine of the standard blower has 220 buckets and these not only must be evenly spaced throughout the circumference of the runner, but each individual bucket must be carefully adjusted so as to give the correct flow lines to the steam. The necessity for careful balance in both the fan and the runner may be understood from the fact that it is common to have these blowers develop a maximum speed of 4500 revolutions per minute. Because of this speed it also has been found necessary to have the weight of the fan approximately balance the weight of the runner.

In casting the runner, the buckets are first placed in notched iron rings, *F*, Fig. 8, which hold them accurately in position. These rings are then built up with spacers, and the whole clamped together to form a single heavy ring which corresponds in size to the outer portion of the pattern.

In Fig. 8, the pattern is shown at *G*. The casting after it has been taken from the mold, and the supporting rings removed is shown at *E*, and in the foreground at is the casting before the rings have been removed. At the right are the rings and loose parts which go to make up the bucket supports. The built up ring containing the buckets is used exactly the same as a core would be used in the process of molding. That is, after the mold has been made, this ring is set in place in the mold and the buckets are so arranged that from each a dovetail end projects out of the ring holder into the space which will form the cast bronze body. It has been found necessary to use a horn gate as shown in the illustration. In this

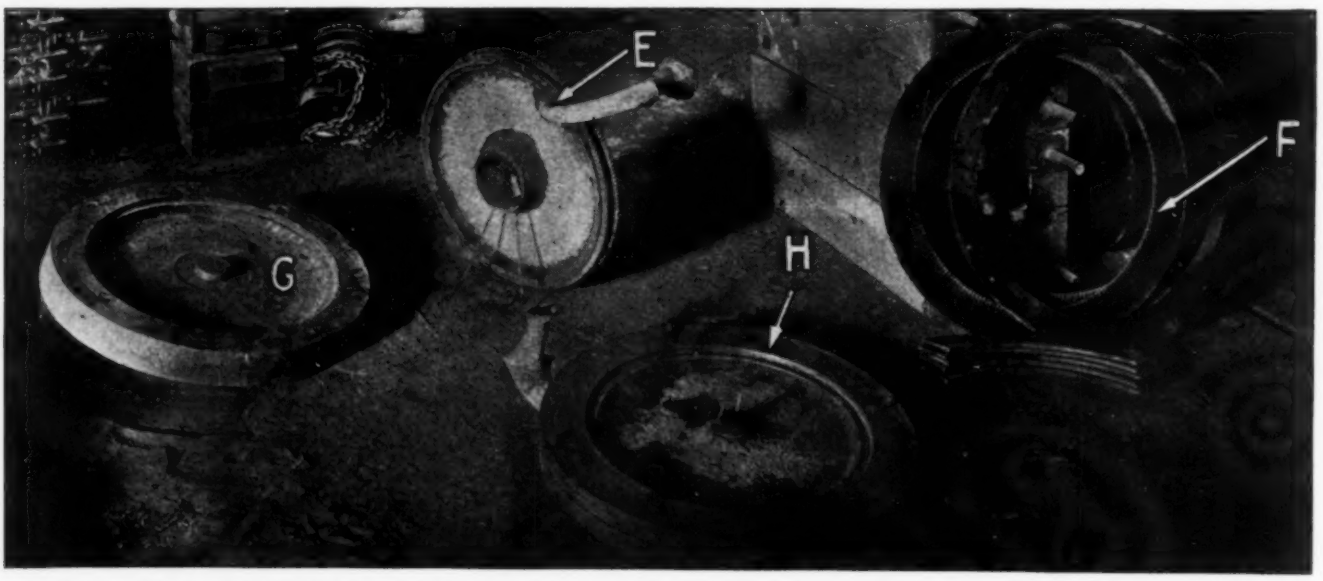


FIG. 8.—THE BRONZE RUNNER IS CAST AROUND THE BASES OF OVER 200 BUCKETS ARRANGED AROUND ITS CIRCUMFERENCE

way, the metal is carefully raised up in the mold without agitation and envelopes each individual bucket so as to make the whole in effect a single casting.

Other castings entering into the complete blower are made along more usual lines. The fact, however, that the product of this particular foundry is almost wholly made up of repetition work means that the entire plant operation differs materially from that of a general jobbing foundry. Standard patterns and core boxes are used from one year to the next. For this reason, much greater care in design is warranted, than where a pattern is used only occasionally for a few castings each time.

The foundry is a brick building with large windows and a monitor roof and is equipped with overhead monorails, chain blocks, and an industrial track which extends from one end of the main room to the other. This main room is divided between nonferrous and iron work approximately at the center, although there is no partition. There is considerable flexibility between the two departments depending upon the work in progress. At the nonferrous end of the plant, as already described, are located the tilting furnaces. This end of the room is shown in Fig. 4. At the left of the furnaces a series of lockers or bins are built in for storage of different metals used in these furnaces. These metals are brought in and weighed and labeled as to weight as they are received and then stored under lock and key. In this way, the melter is relieved of the necessity of weighing each piece a second time before he uses it.

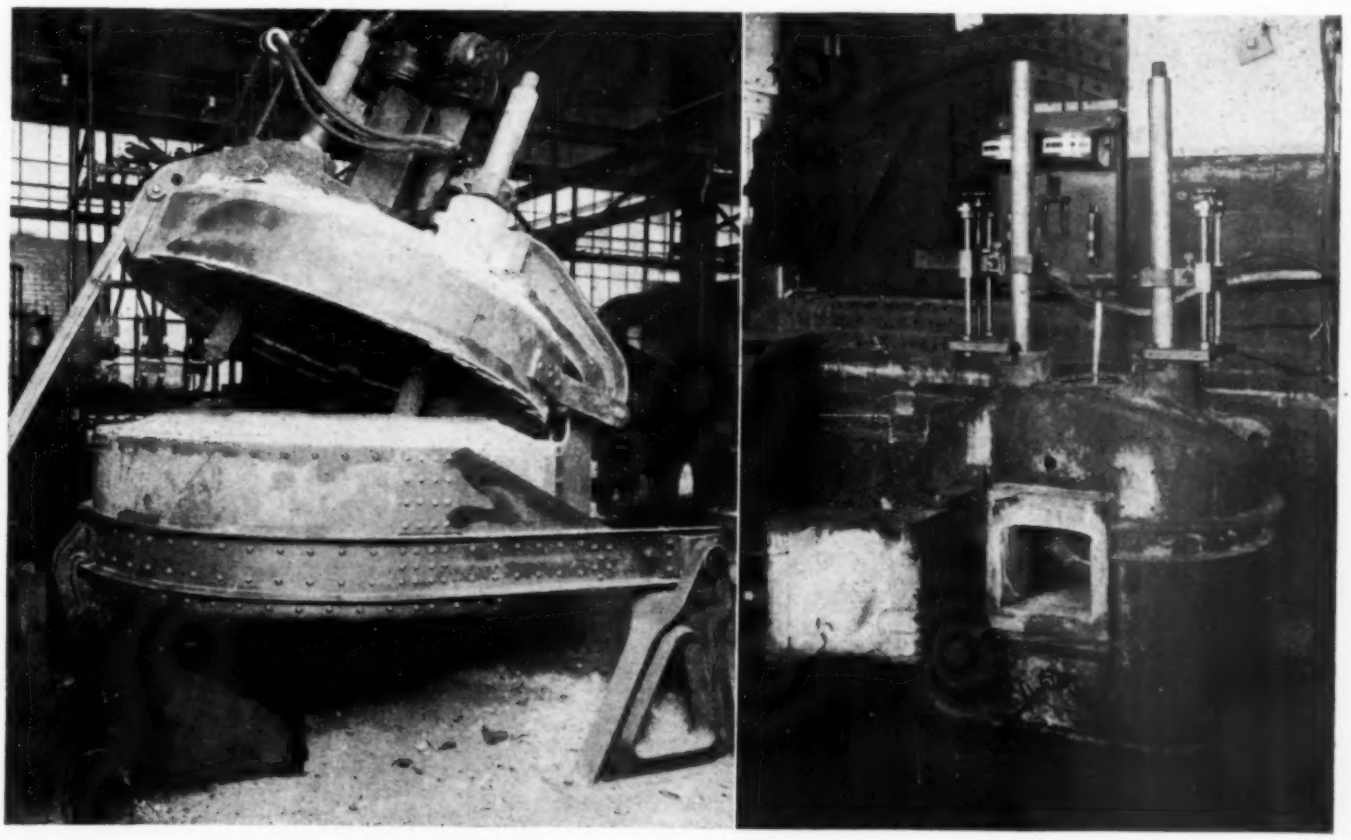
Smothered Arc for Nonferrous Furnaces

TESTS on two new types of electric furnaces developed by the General Electric Co. for melting nonferrous metal are said to show a metal loss for yellow brass of less than 1.5 per cent, and less than 0.75 per cent for red brass. It is also claimed that the thermal efficiency is high and that the expense for refractories and electrodes is reduced to a low value.

These furnaces have been designed in two sizes, a 1500-pound unit and a 50-pound unit, both of which are shown in the accompanying illustrations. Either will melt practically any metal requiring a pouring temperature not exceeding 1500 degrees Cent. The 1500-pound unit is particularly adapted for use in the larger nonferrous foundries, whereas the smaller unit is better fitted for small jobbing foundries, manufacturing plants and laboratories.

Both furnaces work on the muffled arc principle, the main difference in construction and design being due to the variation in size and the fact that the 1500-pound type is three-phase and the 50-pound type is single phase. The power factor for both is .95 or better.

The 1500-pound furnace is said to melt yellow brass, pouring at 1100 degrees Cent., with a power consumption not exceeding 270 kilowatt hours per ton, operating 24 hours a day, with one heat every hour. This furnace is operated on a polyphase circuit and is equipped with electrode regulators which automatically maintain the desired power input. It has a shell built of steel plate, lined with standard fireclay shapes. The roof frame is hinged to a bar at the front of the furnace. The same bar carries a three-legged cast-iron spider which mounts the electrode supporting mechanism. This permits the whole top of the furnace to



THE ROOF OF THE 1500-POUND FURNACE SWINGS ON A BAR ATTACHED TO THE FRAME OF THE FURNACE—A THREE-LEGGED SPIDER SUPPORTS THE ELECTRODE MECHANISM—THE 50-POUND FURNACE—SHOWN AT THE RIGHT—IS BUILT TO CONTAIN A CRUCIBLE

be lifted for inspection or repair of the lining without disturbing the elec-

Three D-shaped muffles with the wearing blocks, cross electrodes and vertical electrodes comprise the heating elements. The space in the muffle between the electrode and wearing block, and the side of the muffle, is filled with crushed graphite to muffle the arc. The triangular space where the cross electrodes meet in the middle is filled with a mixture of graphite and tar to insure a good electrical connection.

The 50-pound furnace is constructed on much the same principle except that in the latter case the hearth is flat, designed to receive standard graphite crucibles. Some difference is also found in the electrode and block arrangement, since the furnace is for single-phase operation. A horizontal carbon block, embedded in crushed graphite, extends across the bottom, carrying bricks which form the hearth. Two graphite electrodes extend through the roof to the wearing blocks, the arcs being smothered in the graphite surrounding the blocks. The electrode regulation is entirely manual and is accomplished by adjusting the wheels on the electrode holders. In operation the crucible containing the metal to be melted is set on the carborundum bricks forming the hearth.

The metal is heated by the same action in both furnaces. The current flows from the vertical electrodes through arcs to the crushed graphite and the wearing blocks. These arcs are smothered by the graphite in the muffles. Thus the whole mass becomes heated, forming a heat source of large area and uniform temperature. The heat is radiated to the metal from all directions as well as being absorbed from the muffles and the hearth.

Insulating Brick Lighten Oven Doors

TWO general types of annealing oven doors are in use in the malleable industry. Doors of the one class are lifted into place by a truck, not being directly attached to the oven as are those of the second class, which swing on hinges. Both types are formed, as a rule, of firebrick held in place by a bolted iron frame. Of necessity, doors not on hinges are considerably smaller than the opening of the furnace as they must be lifted and dropped into place by a truck. This requires the laying of considerable temporary brick work in order to completely close the furnace. During the past few years the labor item of bricking up furnace doors has been rather high. Therefore, early in 1919, experiments with swinging doors were started by the Wisconsin Malleable Iron Co., Milwaukee.

It appeared that many of the ordinary swinging doors were not entirely satisfactory, mainly due to the great weight placed on frames and hinges. A set of two such doors, made of firebrick, would weigh about 10,000 pounds. Accordingly it was decided to try a light-weight insulating brick. A set of two doors was designed. One of the set was made entirely of insulating brick furnished by Armstrong Cork & Insulation Co., Pittsburgh. The other door was built half of insulating brick and half of firebrick, the course of firebrick being laid on the side of the door exposed to the flame. After each run a thin layer of fireclay mud was applied to the exposed surface of the door, built entirely of insulating brick, for protection against the flame.

These doors were in constant service for 18 months before being torn down owing to warping of part of the frame. The insulating brick are in fair shape

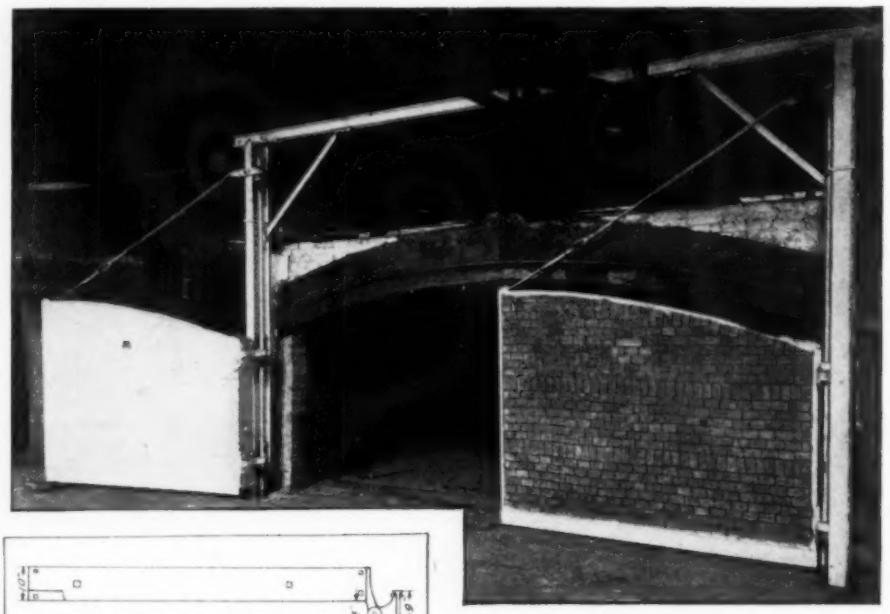


FIG. 2—LIGHT-WEIGHT BRICK ALLOW THE DOORS TO BE SWUNG EASILY ON THE HINGES

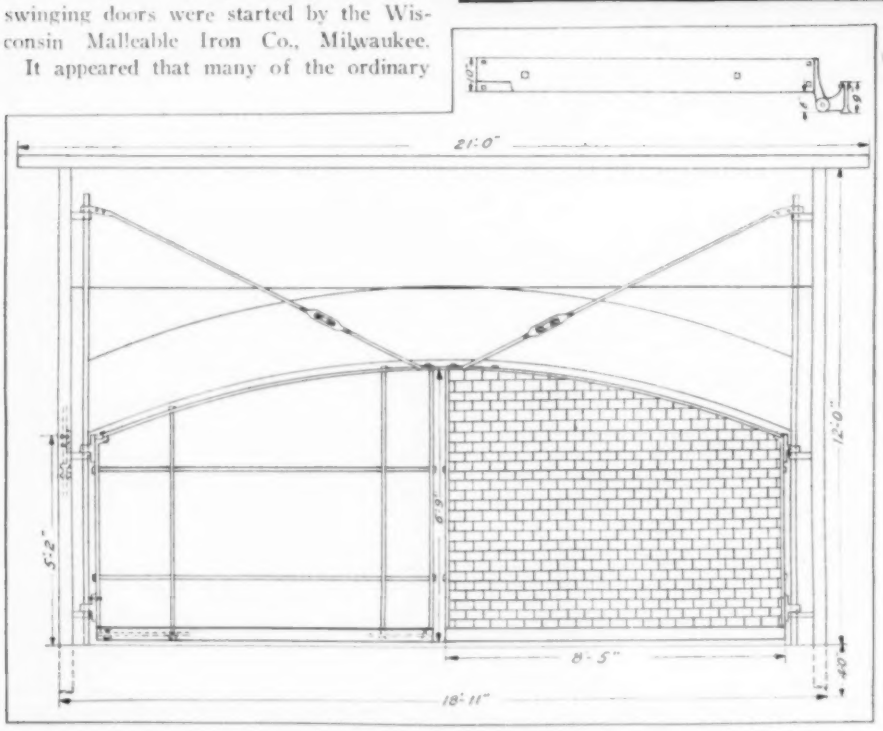


FIG. 1—DETAILS OF SWINGING DOORS FOR MALLEABLE IRON ANNEALING OVENS—NOTE THE CONSTRUCTION OF THE HINGE WHICH PERMITS THE DOORS TO SWING BACK PARALLEL WITH THE FRONT OF THE OVEN

and, after all the old mortar is removed, will be relaid in new door frames. As we have found a considerable saving in the time required to close the ovens and also a probable saving in fuel, we are equipping several annealing ovens with similar doors, using only insulating brick. One of these is shown in the accompanying illustrations.

Most of the metal for frames is inexpensive and can be obtained either new or from house-wrecking companies or scrap dealers. The large upright posts are 10-inch I beams. The cross brace on top is a steel rail about the 50-pound size and is bolted to uprights. One end of each of the uprights is sunk four or five feet in the ground and secured by concrete and broken bricks.

End pieces, and the top of the door frames, are made of air-furnace iron but could be made of iron melted in a cupola. The bottom piece of the door frame is made of a steel I-beam of such size that 9-inch brick just wedges in tight between the flanges. The bottom course of brick is chipped so as to taper a little in order to make a tight fit. Hinges are cast separate and are bolted to the upright beams or to the door frames.

Gangway Left Clear

The doors have shown practically no tendency to sag, any such tendency being taken care of by adjusting turnbuckles on supporting rods. Placing the hinges off center permits the doors to swing all the way round until they are parallel to the front of the furnace. This leaves the gangway clear and is convenient when charging or unloading the furnace.

One unexpected saving in fuel has been effected. This is accomplished by swinging the doors shut as soon as the furnace is empty and thus holding the heat in the oven until new pots are charged.

As compared to the old type of firebrick door, we find the advantages to be in favor of the new kind, in spite of slightly higher original cost. This is due to time saved in bricking up and opening the furnaces, saving in fuel, less warping of doors and reduced weight. This reduction of weight amounts to about 5500 pounds per set of two doors. It is accomplished almost entirely through the substitution of insulating brick, weighing about 1½ pounds each, for 7-pound firebrick.

Furnace Theory and Practice Disagree

BY J. YOUNG

IN THE article referred to here, the authors, James W. Galvin and Charles N. Ring, recount their experience in melting steel in an electric furnace. These steelmakers find, contrary to generally accepted theory, that a deep bath of metal and leaving a heel in the furnace between heats assist in the efficient operation of the furnace. Just why the theory does not agree with the practice is difficult to understand. It would seem to indicate some factors not taken into account by the theory, or an unknown operating step which gives the advantage claimed for the deep bath.

IN THE article, "Heat Modifies Acid Furnace Reaction," appearing in the January 15 issue of THE FOUNDRY certain assertions are made relative to the linings of electric steel furnaces, the slope of the hearth and the heating effect of the current which do not seem to be borne out by theory.

Consider first the heating effect of the current. The heat is generated in an electric furnace from two main sources which follow:

First, from the arc itself. This heat is radiated to the surface of the metal and thence through the entire mass by conduction to the other electrode. No convection heat currents are associated with it as the heat is applied from above. In other words, the furnace could be made so deep that only the upper part would be melted and the lower part would remain cold.

Second, the source of heat is the resistance to the current passing through the metal. This could be expressed as $I^2 R$ losses. The electric resistivity of the charge varies, being higher at the commencement of the heat and gradually dying down as the charge becomes fluid. However, at no time is this resistance great, as the metallic path afforded the current is of a large area. Therefore, the $I^2 R$ losses are small and any heating effect which could be derived in that manner is almost negligible. Increasing the depth of the bath would increase the volume of metal for the current to pass through and so decrease the resistance and heating effect of the current due to the $I^2 R$ losses.

The heat generated in the arc is far greater than that generated by the current in the charge. This can easily be seen if one considers the power consumed in the two parts of the circuit. That the voltage drop across the arc is a large proportion of the total voltage is indicated because if the electrodes are allowed to touch the metal a short circuit results. Therefore, practically all the power is consumed in the arc.

From the forgoing it would seem that for quick melting and high efficiency the following would be ideal conditions for an electric steel furnace:

A shallow bath, of sufficient area to allow the radiated heat from the arc to be conducted quickly through the entire charge.

Electrodes of large diameter, which would spread the arc over a large area and protect the roof from the direct radiation of the arc.

High voltage, which would produce a long arc and so tend to spread it over a larger surface of the charge.

Leaving a certain amount of molten metal in the furnace would tend toward a more constant resistance of the charge at the beginning of the melt, and therefore reduce fluctuations in load. On the other hand, it would tend toward a lower efficiency as the heat lost by it during the charge periods, through radiation, would have to be added to bring it back to pouring temperature.

Seek Graphite Tariff

Among the duties sought by the Southern Tariff association on 57 products of 18 southern states are the following on graphite:

One cent a pound on graphite ore under 50 per cent in graphitic content; 2 cents a pound on graphite ore over 50 per cent in graphitic content; 3 cents a pound on lump graphite; 6 cents a pound on flake graphite; 5 cents a pound on the graphite contained in manufactured graphite products.

These rates are contained in schedules and a memorial filed April 20 with the President and the house ways and means committee, which now is engaged in writing a permanent tariff bill. Chairman Fordney, speaking for the Republican members of the committee, promised a tariff that would protect all industries in all sections equitably without injuring commerce by barring all imports.

Henry Hesse, Anness, Kans., recently has installed a small foundry for making gray iron and aluminum castings.

The Botfield Specialties Manufacturing Co. has changed its name to the Botfield Refractories Co., Swanson and Clymer streets, Philadelphia.

Electricity Applied to Annealing

Pit Furnaces Heated Electrically by Means of Resistance Ribbon Are Described —Pyrometric Control with Either a Single or a Double-Point Recorder Regulates Temperature Closely

BY GEORGE P. MILLS

THE past ten years have seen a gradually increasing application of electric furnaces to steel melting in the foundry. New factors are developing which make possible the economic operation of the electrically heated furnace for annealing and for core baking. The supremacy of this method of heating has been established in only a few cases, but these point to a more universal use in the foundry of this type of heating unit. Therefore, the progressive foundryman is eager to learn all facts regarding the operation of such furnaces, and this article describes what has been learned by one who has broadly experimented with the electrically heated annealing furnace and baking oven.

IN ORDER to better appreciate the present status and future possibilities of the electrically heated furnace as applied to annealing and heat treating steels, it might be well to consider, briefly, these processes from a metallurgical point of view. The term *annealing* may be subdivided into three headings:

First: Normalizing, which consists of heating the steel either above or just below its critical temperature, removing from the furnace and cooling in air. This process when applied to steel castings, relieves the casting strains brought about by uneven cooling when the castings are stripped, and eliminates the hard spots which make machining difficult.

Second: Straight annealing, which consists of heating above the critical temperature and holding for a short time, then cooling slowly by cutting off the heating medium and allowing the material to cool with the furnace. In continuous or semicontinuous furnaces, the material passes through a cooling chamber, so that the heat content of the heating furnace walls is retained, economy improved and production greatly increased. This treatment is used to produce the highest grade of steel castings. Not only are the machining qualities of the castings improved, but the elongation is greatly increased at only slight expense of the ultimate strength.

Third: Dead annealing, which consists of heating the charge, soaking it in a considerable time at the temperature, then cooling in the furnace at a predetermined rate, say 5 or 10 degrees per hour. This process is used on high-carbon alloy steel.

The hardening process consists of heating the metal to above the critical point and quenching. The degree of hardness depends on the rate of cooling in the quenching medium. The more rapid the cooling, the harder and more brittle will be the steel treated.

Tempering or drawing consists of reheating steel which has been quenched to a temperature below the critical point, varying from 450 to 1150 degrees Fahr., depending on the characteristics desired, and cooling in air. The object of tempering is to eliminate the strains set up in quenching, and to render the steel more ductile, while retaining the high tensile strength produced in quenching.

Secures Close Control

Various physical characteristics can be obtained in a given steel by varying the temperature and the time element of treatment. Another important consideration in most of these treatments is that while it is essential to carry the temperature above the critical point, it is desirable to keep near the critical. Any excess above that actually required, tends to coarsen the finished product. In some types of furnaces where it is impossible to determine just what is going on in the furnace, it is a usual practice to run the temperature 50 to 100 degrees Fahr. above the actual critical temperature as a factor of safety. In hardening and annealing excessive time is usually allowed for soaking to be quite sure that the entire mass of the part to be treated is up to temperature.

From the standpoint of the temperature and time element control, the electric furnace is ideal and is being considered in all cases where exceptionally high grade material is to be turned out.

The electric furnace, of the nichrome ribbon resistor type, consists essentially of a strongly fabricated steel shell with a heavy thickness of high grade heat insulating brick laid in three or four courses, with all joints broken. The firebrick lining of the furnace is bonded to the heat-insulating brick so as to produce a solid rugged furnace wall of from 13 to 20 inches thick. The heating element consists of nichrome ribbon, which is exceptionally heavy and rugged. These ribbon elements are distributed over the inside walls and, in some cases, under the roof of the furnace, on insulating hanger brick which are built into the firebrick lining.

A single length of ribbon constitutes each phase. Where splicing is necessary, the joint is heavily reinforced and welded. The phase terminals are brought through the furnace walls in close-fitting insulating bushings to connection blocks on the outside of the furnace. The phases may be connected either delta or *Y* to the power circuit through the control panel. This type of heating unit was developed some four years ago by engineers of the General Electric Co., Schenectady, N. Y. As to the life of the ribbon, there are furnaces which have been operating for over two years day in and day out, and the ribbon shows no deterioration. An interesting example of the lasting qualities of the nichrome heating element is cited in the gun-treating furnaces which were installed by the government at the plant of the Tioga Steel & Iron Co., Philadelphia early in the war. After operating a year these furnaces were dismantled, and the ribbons were straightened, shipped to Charleston, W. Va., reformed and built into new furnaces of a different size, at the naval ordnance plant. These furnaces are now in operation. This is a proof that there is no appreciable deterioration or crystallizing of the structure of the ribbon.

The maintenance and repair charges

Paper presented at a recent meeting of the Philadelphia section of the Association of Iron and Steel Engineer's club. The author, George P. Mills, is electrical engineer, the Electric Furnace Construction Co., Philadelphia.

on the ribbon-resistor-type furnaces installed have been negligible. This is the logical result of working out the principle and design of this type of furnace. It is the simplest of all types of furnace from a construction standpoint. No combustion chambers, flues, port holes, false bottoms or double arches whatever are involved. The hearth, walls and roof, all being solidly constructed, can be insulated to the best advantage to prevent loss of heat. At the temperatures involved, the maximum never going higher than 1800 degrees Fahr., the firebrick used, as well as the hanger brick, have a coefficient of expansion nearly zero. The result is a tight furnace in which all mechanical strains are reduced to a minimum. The lining does not crack, spall or run. These facts are important, of course not only from the standpoint of small maintenance costs, but there is no lost production due to shut-downs for repairs. Due to the fact that the ribbon resistor may be formed in any reasonable shape and distributed over the interior of the furnace, remarkably uniform temperatures are obtained throughout the furnace.

The ribbons are distributed so that extra heat energy is dissipated inside of the furnace at the points requiring the most heat, in order to maintain uniform temperatures. In the smaller furnaces where a single control is used, additional heat is generated near the doors by doubling the heating element back for a short distance, thus developing twice the B.t.u's in this portion of the furnace where the radiation losses are greatest.

Temperature Control Important

The temperature control which is the most important feature of the electric furnace is operated by the *on-and-off* principle, that is, power is cut off when the temperature of the furnace reaches a predetermined high setting and is cut on again when it falls to a predetermined low setting. This operation is accomplished by means of a thermocouple which is placed on the surface of the charge, actuating a recording controller. The sensitivity of the control instrument is plus or minus ¼ per cent of the range of the chart. If the chart of the instrument has a scale of from 200 to 1800 degrees Fahr., the chart range would be 1600 degrees and the sensitivity of the instrument would be ¼ per cent of this range or 4 degrees.

The on-and-off principle of temperature control has a number of advantages over the variable voltage control in that the heating elements are designed for operation on standard power voltages—110, 220, 440 or 550 volts on either single, two or three phase, 25 or 60 cycle or direct current. Often, excess capacity in the existing power transformers can be used to advantage in the electric furnace. In cases where additional transformers have to be installed to take care of the furnace load, these transformers are of standard type and may be purchased to line up with existing power transformers.

The fact that the load is thrown on and off suddenly will produce no disturbances in the line. On large furnaces the power is controlled in sections so that only a small part of it is actually thrown on or off at any given instant. The usual maximum of a single zone is somewhat less than 250 kilowatts. However, the chief advantage of this method of control is that it is entirely automatic and eliminates the manual operation which is necessary in rheostatic or transformer tap control.

The two-point recorder controller has the particular advantage of indicating the moment when the charge in the furnace is completely soaked, and is used in all cases where this indication is of importance. Two thermocouples are registered in each heating zone, one placed adjacent to the heating element and one placed on the surface of the charge. When a cold charge is placed in a hot furnace the ribbon gives up its heat rapidly to the cold charge, its temperature is quickly reduced and that of the charge increased. As the temperature increases, the two temperature curves become closer together, indicating a low temperature gradient, the power, of course, being on all the time. As soon as the surface of the charge reaches the predetermined temperature, in this case, 1500 degrees Fahr., the power is cut off. As only the surface of the charge is then up to temperature the inner mass rapidly absorbs heat from the surface, and quickly decreases the temperature to a point where the power is again thrown on the furnace. The surface of the charge is once more heated up to 1500 degrees when the power is again cut off. This cycle is repeated until the whole mass of the charge is up to temperature.

On the single-point recorder, the time of soaking is also indicated, although not so clearly as in the double-point recorder. When the surface of the charge is up to temperature, the power is cut off in the same manner as with the two-point recorder. The temperature of the surface drops rapidly, making a steep curve to a point where the power is thrown on again. It requires some little time for the temperature to come back to the predetermined value and the curve has a slow rise to a point where power is turned off. This cycle is repeated continuously and, after a short period, the saw tooth effect of the curve is reversed, that is, the heating-up curve, while the power is on, is steep and the cooling-down curve, while the power is off, is not so steep, indicating that heat is going into radiation losses only and not being taken up by the charge.

Measures Temperature of Charge

The temperature control of the electric furnace is unique in that the actual temperature of the charge is measured within the accuracy of the thermocouple. This is due to the fact that the atmosphere in the electric furnace is dead and the charge and furnace are brought to temperature by radiant heat. In the case of combustion furnaces, the charge is heated by being surrounded by rapidly moving gases which necessarily require a high temperature gradient between the moving gas and the charge. In the majority of cases the thermocouple of the combustion furnace is located so that hot gases impinge on it, and the temperature of the gas, and not of the charge, is recorded. For this reason, it is often necessary upon the installation of an electric furnace to reduce the apparent temperature at which the work is treated.

An interesting instrument, known as the rate-of-change controller, has been developed in conjunction with electric furnace work, so that an entire cycle extending over a period of 144 hours or longer may be automatically controlled. When using the rate-of-change controller in connection with the electric furnace, for annealing ball-bearing steel; carbon, 0.90 to 1.10 per cent; chromium, 1.15 to 1.30 per cent, the entire operation after closing the control switch at the beginning of the cycle is carried out automatically. On the furnace mentioned, it is contemplated bringing the charge and furnace up to 1440 degrees Fahr. in 18 hours, so that in order to get a soaking of 48 hours, it is necessary to set the rate-of-change instrument to begin operation 66 hours after starting up. The temperature setting of the instrument is then automatically reduced at a uniform rate of 10 degrees per hour until the 900 degrees Fahr. is reached. During this cooling period of 54 hours, the heating elements are energized only a small por-

tion of the time, being just sufficient to make up the radiation losses in excess to what would be equivalent to the cooling rate of 10 degrees per hour. At the end of the 54-hour cooling period the power is automatically cut off the furnace which then cools at the natural cooling rate until 600 degrees Fahr. is reached.

The character of the load of such a furnace as has been described is ideal for the power station in that it is balanced and of unity power factor. The load factor is high and in some cases the heating cycle can be arranged so as to use off-peak power, although the most efficient operation is on a 24-hour basis. The space occupied by the electric furnace is small compared with that occupied by other types, especially when account is taken of the space required by fuel-fired furnaces for accessory apparatus and fuel storage. The working conditions around the electric furnace are excellent. It is cool and there are no fumes, no dirt, no noise.

Up to the present time, approximately 12,000-kilowatt capacity in ribbon-resistance-type furnaces, for temperatures of from 1000 to 1800 degrees Fahr. have been installed or contracted.

A car-type annealing furnace for steel castings is installed at the Connecticut Steel Co., Hartford, Conn. This furnace is 36 x 54 x 32 inches high and has a capacity of 40 kilowatts. With a charge of 1000 pounds on a cold car bottom, it will come to a temperature of 1500 degrees Fahr. in 3½ hours.

For most efficient use, such a furnace should be run continuously, which necessitates the provision of a cooling chamber. A furnace of this type, having a capacity of 180 kilowatts, for the annealing of wire, has recently been put into operation. This furnace has, in addition to the heating chamber, a double recuperative chamber where the outgoing work preheats the incoming charge. The preliminary tests indicate the furnace will have an operating efficiency of well over 90 per cent.

Annealing Furnace Installed

A castings annealing furnace of the pit type recently has been installed by the Electric Furnace Construction Co. at the plant of the Emery Steel Castings Co., Baltimore. The Emery Steel Castings Co. also has in operation a mold-baking oven 6 feet 10 inches x 12 feet x 6 feet 4 inches high, which has a capacity of 126 kilowatts. The oven has an output of one thousand 6 x 8 x 12-inch molds per 24 hours.

An interesting layout has been made of a furnace for annealing 120 tons of steel castings per 24 hours. This furnace will consist of two parallel heating chambers each 8 feet 6 inches wide x 44 feet long. On each end of the heating chambers a common recuperative chamber 18 feet wide x 22 feet long will be located. The castings will be carried on cars 7 feet wide x 11 feet long, which will pass through the heating chambers in opposite directions, the cold incoming charges being preheated in the recuperative chambers by the hot outgoing charges. A transfer table and a self-contained motor driven hydraulic pusher are to be at both ends of the furnace.

On each side of the furnace there will be two cars preheating, four cars in the heating chamber and two cars cooling. Every car will be in the heating zone 2 hours and in each of the recuperative chambers 1 hour. The operation of the furnace will require 17 cars, 8 in each side and 1 unloading and loading. The total connected load of the furnace will be 1885 kilowatts and this will be divided into control zones, four in each heating chamber.

Two important considerations to be taken into account in the laying out of a new furnace are:

First, the relation of the size of furnace to the output. The electric furnace should be loaded to capacity at all times. If the production is expected to vary widely, two or more furnaces should be installed to insure capacity operation on the ones that are running.

Second, handling equipment and devices should be co-ordinated with the furnace. High grade work can easily be spoiled in handling from the furnace, regardless of the fact that the furnace itself might be working perfectly.

Good Rigging Essential in Sweep Molding

BY GEORGE BOYS

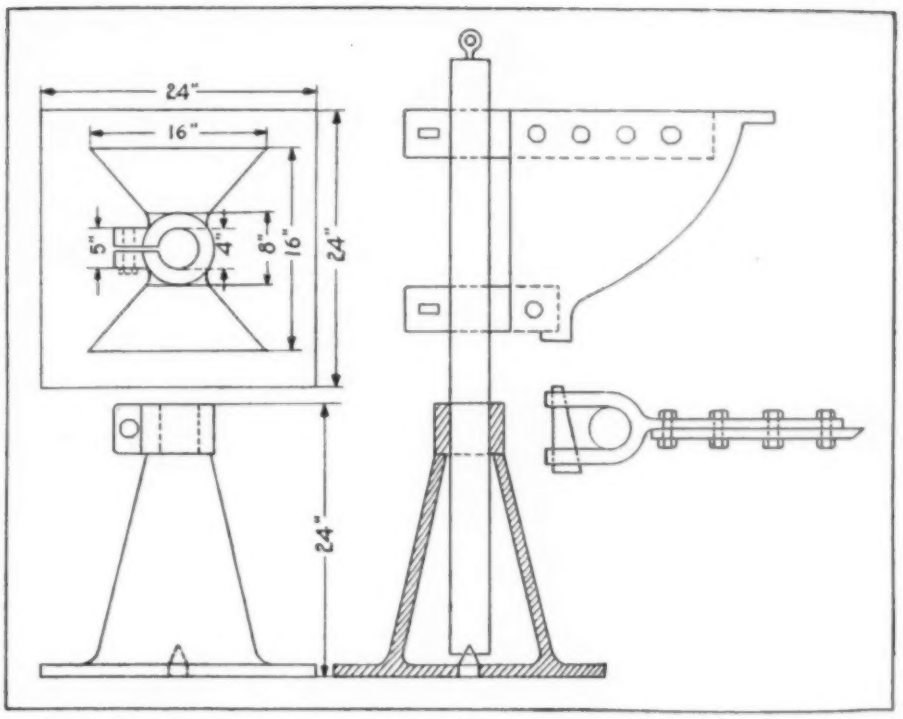
DURING a discussion the other day with an old-time molder who had traveled around the globe for thirty years or more, working in all kinds of shops and doing all classes of work, the conversation turned to the remarkable progress made in foundry work, particularly in machine molding. The writer recalled the time when it was possible to travel from one end of the country to the other without finding in any of the leading foundries a machine of any description, except here and there a gear molding machine. In those days the majority of the foundries had to depend entirely upon the skill of the molder and endeavor to increase their products through the various methods devised by the molder or foreman, or of both combined. Very often a job that is new and unusual will come into a shop, but let the pattern remain around for a few days and sooner or later some of the men will be ready with ideas as to how it should be made and how a certain flask could be adapted to it. Perhaps someone had worked where that job, difficult as it seemed, was just an everyday job, where they were properly equipped to handle it.

This brings out the thought that the time is not far off when jobbing foundries will be compelled to engage men (as production engineers are engaged) whose duty it will be to work in conjunction with foundry superintendents and foremen for the purpose of standardizing jobbing foundry methods. This position necessarily will call for a broad experience in all classes of work, particularly in the work under his immediate supervision. These supervisors could be divided into various classes, for to take a man into a *jobbing* shop whose only experience had been gained in a *stove* shop would certainly tend to defeat the end he was engaged for. Likewise, a man could be a very clever rigger in small work and still not be worth his salt in big jobbing work. The reason for advocating this practice is to be found in the positive fact that today there are foundries using entirely different methods to obtain the same results, one foundry being successful at once, the other only after repeated failures. Some foundries, after trying out and experimenting with different plans, have reached the point where the success of any particular job is assured, but the amount of time and money thus expended has been altogether out of proportion to what it would have been had they been able to use the right method at first. This may seem a trifle far-fetched, but any molder who has traveled around can tell surprising and almost unbelievable stories of failures to produce good castings at the first trial, and of the many and va-

rious types of rigging now in use at the different shops. One may travel the country over and find in shops devoted to sweep and strike work different devices, often of a most ludicrous character, for the loam molders to work with, instead of there being some simple and standardized rigging. How many shops today are still using the same methods which were in vogue fifty years ago? By this it is not meant to infer that the old-time loam molder could not and did not use them to produce good work, but to see some of the devices attached to the walls of certain foundries, to examine them, and then to realize how unfitted and inadequate they are, makes one wonder at the amount of time and patience which must have been expended and lost.

As an illustration of the above point, the writer, after many years' experience in many shops and after encountering and having to work with so many classes of spindles and spindle centers and holders, some of which were useless and some so complicated as to require a special man to rig them up, finally adopted the one shown in the accompanying sketch. This rig has proved itself simple and sure, needs no wall supports whatever, can be bolted to a top or bottom plate or used partly in the ground, or level with the floor. All that is required is to place it where needed, level it and make it immovable. This can be done by placing it in a hole or by ramming a flask around it if it is to be used on the level floor. The spindle is then picked up by the eye-bolt (see sketch) and placed in the holder. If the spindle has been bored to fit the taper plug on the holder it will be impossible for the casting to be other than perfectly round. When finished with, the spindle can be lifted out with the crane and taken away until needed again, and when brought back it adjusts itself. Every molder readily will realize that since there are no wall attachments to adjust, or to get out out of plumb, his spindle is always absolutely reliable, regardless of the number of times it is removed.

All this brings back the suggestion concerning the need of an expert, well versed in different types of rigging, acting as supervisor to a number of associated jobbing foundries. He would be in a position to aid the foreman with reasons and suggestions for and against certain methods, and because of his greater experience would be able to direct the work along lines more certain to produce the best results. The writer recalls the casting of two four-ton hydraulic cylinders in a certain foundry about three years ago, which serves to emphasize the need of these experts. These cylinders were first cast without a head and were lost. They were then re-cast with an extended



PLAN, ELEVATION AND SECTIONAL VIEW OF SPINDLE HOLDING DEVICE

head about 15 inches long, the same size as the body of the cylinder. These stood the test and were cut off clean and solid. A little advice here would have saved a lot of money and considerable time.

The case of a well-known engineering company further illustrates this point. This company had been forced time and again to change the management of their foundry, owing to the enormous losses occurring almost daily. The work consisted mostly of sugar mill rolls and evaporators up to 14 feet in diameter, and general jobbing. After the writer had been called in an investigation showed that some of the losses were due to the castings cracking, being out of round, or thick and thin in places. The cause for all this readily was seen. The spindles and holders, with wall attachments, which had been in use for many years, were found to be so complicated and ingenious as to almost baffle description, yet they had been adopted and used by men brought from outside who possessed full power to change them, but never had done so. Castings made with this sort of rigging were irregular in form and cores were so much out of round that to get them into a mold was almost impossible. This refers mostly to the steam belts, etc. All work of this character was immediately stopped and a pattern conforming to the accompanying sketch was made. Castings were then made as quickly as possible, sent to the machine shop, bored, and the top of the boss was faced for leveling purposes. A hole was then drilled in the center of each base (see sketch), and a taper steel pin driven in tight. It was then ready for the spindle, which had been finished true in the lathe, cut to length and countersunk in the bottom to receive center-pin. These spindles are from 6 to 10 feet in length and have been in use for the last two years, giving complete satisfaction to the men, who take pride in knowing that their castings are always true to thickness and round, which, after all, is a great consideration where castings have to be built on top of each other and all flanges come equal and true.

Open Southern Office

The Brown Hoisting Machinery Co., Cleveland, recently has opened a southern office, 530 Whitney-Central building, New Orleans. The states of Texas, Louisiana, Mississippi, Alabama, Georgia and Florida will be covered from this office. Charles H. White is in charge.

Foundry Company Makes Lease

The Western Reserve Foundry Co., of Cleveland, has taken from Alva and C. H. Bradley and C. F. Meade 220 feet on Marquette avenue N. E. and the Nickel Plate railroad for five years at $10,000 a year, with an option of renewal for an additional five years.

Wonham, Bates & Goode, New York City, agents for the Whiting Foundry Corp., Harvey, Ill., the Orton & Steinbrenner Co. of Chicago, and other manufacturers, have moved their offices from 17 Battery Place to 251 Fourth avenue.

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Sand Question Deserves Consideration

DESPITE the fact that the grade or quality of the sand employed in a foundry is one of the most important factors entering into the cost of castings production, in many cases this feature is given little or no consideration. That material is listed as molding or core sand, as the case may be and that it can be purchased at a favorable figure apparently are the only considerations that have any weight. The manner in which it is prepared for the use of the molders, also, is important and while this phase of the question undoubtedly has received and is receiving more consideration than formerly, still in a great many instances there is room for improvement.

Where the molders are accustomed to tempering their own sand and where they are familiar with its peculiarities, fairly satisfactory results are attained even with sand not particularly suited to the work in hand. However, the results will be still more gratifying if a proper grade of sand always is employed. In plants where, for the most part, men have been broken in as molders after a short course of intensive training and where the sand is prepared in bulk and distributed by men who are not concerned with its ultimate fitness or unfitness, the problem is entirely different. Individual judgment on the molder's part, as to the condition of the sand, is neither expected nor invited. He uses the sand that is supplied to him and if on piecework, he accepts his discount on bad castings as something over which he has no control. The problem of furnishing satisfactory sand clearly is up to the executive in charge of operations.

The percentage of bonding material and the relative size of the grains of sand determine to an approximate degree the classification of molding sands. The clay content has an important bearing on the fusibility, bonding strength and porosity, while the size of the grains determines whether the sand is suitable for certain classes of work. A series of laboratory tests may give the chemical analysis, the size and shape of the grains and what percentage will pass through a certain size screen. The data thus secured will furnish a valuable index on which to base specifications for future shipments.

Unfortunately, the great majority of foundries are not equipped to conduct elaborate laboratory experiments and while a considerable amount of research work has been carried out both by the United States bureau of standards and by private enterprise, the information so far secured has not become available to any great extent.

The status of the molding sand situation in the foundry trade today, practically is the same as that of the iron mixtures used in the foundry 30 years ago. Common sense and experience played an important part in selecting the iron in those days and while the old time foundryman could not give the percentage of the component parts of a casting, he could and did produce satisfactory work.

While an accurate and scientific knowledge of the properties of sand, at least in its application to the foundry, is desirable and eventually will be as common among foundrymen as analysis of iron has come to be, in the meantime an application of common sense must be depended upon to eliminate a great deal of the loss due to unsuitable sand or to sand that is improperly prepared on the foundry floor or used without proper inspection.

Trade Outlook in the Foundry Industry

APRIL has brought little encouragement in the industrial situation. The month has been characterized by a waiting attitude and the depression has been general throughout all lines of manufacture and in all sections of the country. In many quarters, the arrival of May 1 is expected to give some indication of future developments. Building construction in many centers awaits the settlement of questions of employment which must be met at the date mentioned.

Construction Needed

No doubt exists that a tremendous shortage of dwellings is to be found in the cities. Even with the trend of population away from the large centers in the past few months, and the evident tendency to live under more crowded conditions, a real need for construction is apparent. That this is plain to those foundry interests which derive their business from the various classes of domestic castings, may be noted from the provisions which are being made by the large manufacturers of sanitary ware, plumbers goods, and heating equipment to maintain their stocks of materials. Pig iron sales within the past two months, with the exception of small car load lots have been confined to foundries which make some of the essentials to housing construction. One of the large companies which makes bathtubs has purchased large tonnages of iron and has maintained production even though orders disappeared and cancellations were prevalent. The company during the past two weeks has curtailed its operations to some extent, but still is manufacturing for stock. Although reports indicate that April construction figures will be far below those of last year, a marked increase is noted in the number of small projects which are undertaken.

Prices of Raw Materials for Foundry Use

CORRECTED TO APRIL 22

Iron		Scrap	
No. 2 Foundry, Valley	$24.00 to 25.00	Heavy melting steel, Valley	$12.00 to 12.50
No. 2 Southern, Birmingham	23.00 to 25.00	Heavy melting steel, Pitts.	12.00 to 13.00
No. 2 Foundry, Chicago	25.00 to 26.00	Heavy melting steel, Chicago	11.50 to 12.00
No. 2 Foundry, Philadelphia	25.75 to 26.85	Stove plate, Chicago	15.00 to 15.50
No. 2 Foundry, Buffalo	25.00 to 26.00	No. 1 cast, Chicago	15.00 to 15.50
Basic, Valley	22.50 to 25.00	No. 1 cast, Philadelphia	18.00 to 19.00
Basic, Buffalo	25.00 to 26.00	No. 1 cast, Birmingham	15.00 to 16.00
Malleable, Chicago	25.50 to 26.00	No. 1 cast, Buffalo	17.00 to 18.00
Malleable, Buffalo	25.50 to 26.00	Car wheels, iron, Pittsburgh	15.00 to 15.50
Coke		Car wheels, iron, Chicago	14.50 to 15.00
Connellsville foundry coke	$4.50 to 5.50	Railroad malleable, Chicago	13.50 to 14.00
Wise county foundry coke	6.50 to 8.00	Agricultural mall., Chicago	13.50 to 14.00
		Railroad malleable, Buffalo	11.50 to 12.50

Outlook Brighter

During the past two weeks, some signs of betterment are noted in the railroad situation, although in this same period the idle car figures still give indication of the general business stagnation throughout the country. Abrogation of the national agreements is taken by the railroads as the first step in effecting economies both through lowering wages and increasing efficiency of operation. The need for freight rate adjustment is preeminent in bringing about better conditions Some improvement is noted in the amount of railway repair business which is offered to malleable foundries, while in the East an increased inquiry for new railroad equipment is developing. Probably the outstanding feature of the past two weeks has been the betterment in automotive manufacture. The demand for passenger automobiles has increased, a number of the largest manufacturers have resumed operations on increased schedule and the foundries supplying this important branch of industry have received orders for increasing tonnages of castings. However, many, even of those who are directly associated in the manufacture of cars, regard this improvement as merely seasonal, and few express confidence in its continuation throughout the summer as usually is expected.

Improved in March

Reports from the traffic department of the National Automobile Chamber of Commerce, from factories producing two-thirds of the total volume show that in March 16,500 carloads of automobiles were shipped and 10,000 dirven away. This shows an increase of 63 per cent over February. In March last year, 29,326 carloads were shipped and 57,273 were driven away, and this constituted a record month. An increase in the sale of used cars also is taken as an indication of improvement. Both coke and pig iron apparently have touched the low point in the production curve. During the past few weeks the tendency has been toward further curtailment, but within the week of April 18, an apparent balance was reached in both these commodities and a slight increase was noted. Cast iron pipe inquiry has improved and the sale of several large tonnages gives promise of still further betterment. Foundries making this class of product, both in the East and South look for a pick up with the next few weeks, while makers of soil pipe and fittings are fairly active, producing stock. Interest is evidenced on the part of foundries in the East in the requirements of the proposed New York-New Jersey vehicular tunnel. It is expected that plans for this tunnel, which will be issued for bids within the next month or two, will specify at least 150,000 tons of cast-iron tunnel segments. A reduction of from 10 to 15 per cent has been made in the price of several important lines of machine tools, and while orders are not numerous, a slight betterment is noted. Jobbing shops making castings for this class of manufacture have been particularly hard hit during the past few months. A survey recently completed in Cleveland indicates that the operations of all shops reporting averages 24 per cent. However, even this figure is high, as the larger shops report the lower averages.

Brass Orders Increase

A significant feature of the operations shown in the Cleveland district is the increasing activity of brass shops. Betterment in automobile manufacture has assisted nonferrous foundries, and plumbing goods are moving more readily. Prices for nonferrous metals, based on *The Daily Metal Trade* for April 22, follow: Casting copper, 11.75c; Lake Copper, 13.00c; lead, 4.25c; antimony, 5.37½c; aluminum, No. 12 alloy, producers' price, 27.30c and open market, 18.50c to 20.50c. Zinc is 4.85c to 4.90c. E. St. Louis.

Comings and Goings of Foundrymen

W. H. McFADDEN, Ponca City, Okla., past president and for a number of years a director of the American Foundrymen's association, recently has started upon an extensive hunting trip which will cover New Mexico, Arizona, Colorado, Utah and Idaho during the present spring and summer and ending in the fall in Montana. Later the trip will be renewed in Montana and the party will push northward into Canada and its various northern and northwestern provinces, terminating eventually in Alaska. Mr. McFadden, who will be accompanied by his wife and several personal friends, expects to consume a total of three years with 7 months given to the trip northward through the Rocky mountains to Montana. Until last year Mr. McFadden had served as mayor of Ponca City continuously for 7 years. He retired voluntarily at the time mentioned.

Daniel Silvester has engaged in business under the name of the Jamesville Brass Foundry Co., in Worcester, Mass.

Alexander C. Brown, president of the Brown Hoisting Machinery Co., Cleveland, has been elected president of the Cleveland chamber of commerce.

Marcel Garsaud has been appointed New Orleans sales agent for the Whiting Corp., Harvey, Ill., succeeding J. S. Barelli.

Augustus N. Kelley has resigned his position as superintendent for the Modern Foundry Co., Oakley, Cincinnati, effective June 1.

William Mugan, who was superintendent for the Monighan Foundry, Chicago, and previous to that the Barnum & Richardson Foundry, has been made superintendent of the Mortimer Foundry of that city.

Walter E. Daly, secretary and treasurer of the Pioneer Alloy Products Co., 10601 Euclid avenue, Cleveland, departed May 1 for a trip to South America which will include Rio de Janiero and Buenos Aires.

C. F. Herington has been made vice president of the Holbeck Engineering Co., Cleveland. Mr. Herington for the past five years has been mechanical engineer and district sales manager in Chicago for the Bonnot Co., Canton, O.

George W. Reese recently was presented with a diamond studded watch charm by the employes of the Lorain Steel Co., Pittsburgh. Mr. Reese has been foundry superintendent for this company for 30 years.

S. R. Costley, who has been absent from duty some months, has resumed his position as salesman for the J. S. McCormick Co., Pittsburgh.

J. E. Morley of Cleveland, H. A. Gillis of Washington, and W. E. Parker of Sheffield, Eng., have been elected directors of the Hadfield-Penfield Steel Co., Bucyrus, O.

C. Judson Day, secretary of the National Cast Iron Pipe Co., Birmingham, Ala., is making a tour of branch offices and inspecting the new pipe warehouse of his company in Chicago.

Charles H. White has been made manager and placed in charge of the southern office of the Brown Hoisting Machinery Co., Cleveland, which recently was opened at 530 Whitney Central Building, New Orleans.

A. O. Mortimer heads a new foundry known as the Mortimer Foundry, which recently occupied a new plant at 2443 West Twenty-first Place, Chicago. Mr. Mortimer formerly was manager for the Monighan Foundry Co., Chicago.

Victor T. Goggin, formerly New England sales manager of Fred. T. Ley & Co., Inc., of Springfield, Boston and New York, has associated himself as contracting engineer with Dwight P. Robinson & Co., Inc., New York.

H. F. Roush has been appointed plant manager for the Shreve Foundry Co., Shreve, O. Mr. Roush formerly was foundry superintendent of the Davis Sewing Machine Co., Dayton, O., and previous to that time was superintendent of the Platt Iron Works of that city.

H. S. Washburn, secretary and W. Stewart foundry superintendent of the Turner & Seymour Mfg. Co., Torrington, Conn. have resigned their positions and with Charles F. Conlon have incorporated a new company to be known as the Plainville Casting Co., Plainville, Conn.

H. M. Davison, who for the past two years was general sales manager for the Ohio Locomotive Crane Co. and previous to that time with the Hayward Co., 50 Church St., New York, has again become associated with the latter company and will have the general management of sales.

John A. Penton sailed for England on the Olympic, April 20, to attend the spring meeting of the British Iron & Steel Institute. He has completed arrangements to visit a large number of the important iron and steel plants in England, Belgium and France, including Lorraine, before his return to America in July.

C. J. Houck, who recently was made foundry superintendent for the Vulcan Iron Works, Denver, Colo., previously was connected with the Rumely Mfg. Co., LaPorte, Ind.; Flint & Walling, Kendallville, Ind.; King Sewing Machine Co., Buffalo, N. Y., and Timken-Detroit Axle Co., Canton, O. Until recently Mr. Houck was with the Graebler Mfg. Co., Chicago.

Meetings Planned by the Institute of Metals

The Institute of Metals which was founded in Birmingham, England, in November, 1908, is to pay its first return visit to that city for the Autumn meeting on Sept. 21-23 next. There now is a membership of 1350 and a large attendance is expected. The proceedings will include a reception by the Lord Mayor of Birmingham, visits to the University and local works. The eleventh May lecture of the institute is to be given in London by Professor Turner on May 4th on "The Casting of Metals."

Recounts Phases of Life in Central Europe

Some phases of the political, social and industrial situation in Central Europe formed the subject of discussion at the regular April meeting of the New England Foundrymen's association in Boston, Wednesday, April 13. D. R. Yarnall, Yarnall & Waring Co., Philadelphia, who has just returned from a six months tour of central Europe, was the speaker. His remarks were based upon personal observations.

Plan Spring Meeting of Engineering Society

The 1921 spring meeting of the American society of Mechanical Engineers is to be held in Chicago, May 23-26, at the Congress Hotel. Well developed programs will be presented by the professional divisions of the society devoted to forest products, fuels, machine shop, management, material handling, power, railroad, and a specially important session will be devoted to

training for industries. The Chicago committee, jointly with the Western Society of Engineers, is preparing a session on "Chicago as the Rail-Water Gateway". Visits to a great number of points of engineering interest in Chicago will be arranged. Special attention is being given to the correlation of plant visits with the technical sessions.

En route to the meeting, the Society, jointly with the Society of Automotive Engineers, will stop at McCook Field on Saturday, May 21st, for an inspection of the facilities of the field.

On May 27-28, the Friday and Saturday following the meeting, a joint excursion with the Army Ordnance association will proceed to Rock Island Arsenal, where the ordnance division will present papers and inspect the plant.

Cost Accountants to Meet in Cleveland

The program of the annual convention of the National Association of Cost Accountants which is to be held in Cleveland, Sept. 14, 15 and 16, has been issued. It provides for three days of conferences on practical cost questions, including, "Interest as an Element of Cost", "Cost Systems as a Means of Preventing Waste", "Uniform Methods and Standardized Costs", and a number of similar topics. Charles R. Rauth is director in charge of the meetings. Stuart C. McLeod, 130 W. 42nd street, New York, is secretary.

Abrasive Manufacture Is Visualized by Film

At the April meeting and dinner of the Pittsburgh Foundrymen's association held at the Hotel Chatham, Pittsburgh, April 18, at 6:30 p. m., the Carborundum Co., Niagara Falls, N. Y., presented "The Jewels of Industry". This is an entertaining and instructive industrial motion picture showing the making of modern grinding materials. It tells the story of the manufacture of carborundum, etc., in electric furnaces as well as the making of grinding wheels.

Sand Mixer Has Capacity of 15 Cubic Feet

The facing and core sand mixer shown in the accompanying illustration recently has been placed on the market by the Standard Sand & Machine Co., Cleveland. This new size machine with a capacity of 15 cubic feet or about 5 wheelbarrow loads has been developed in response to a demand from foundrymen for a machine with a larger capacity than usual.

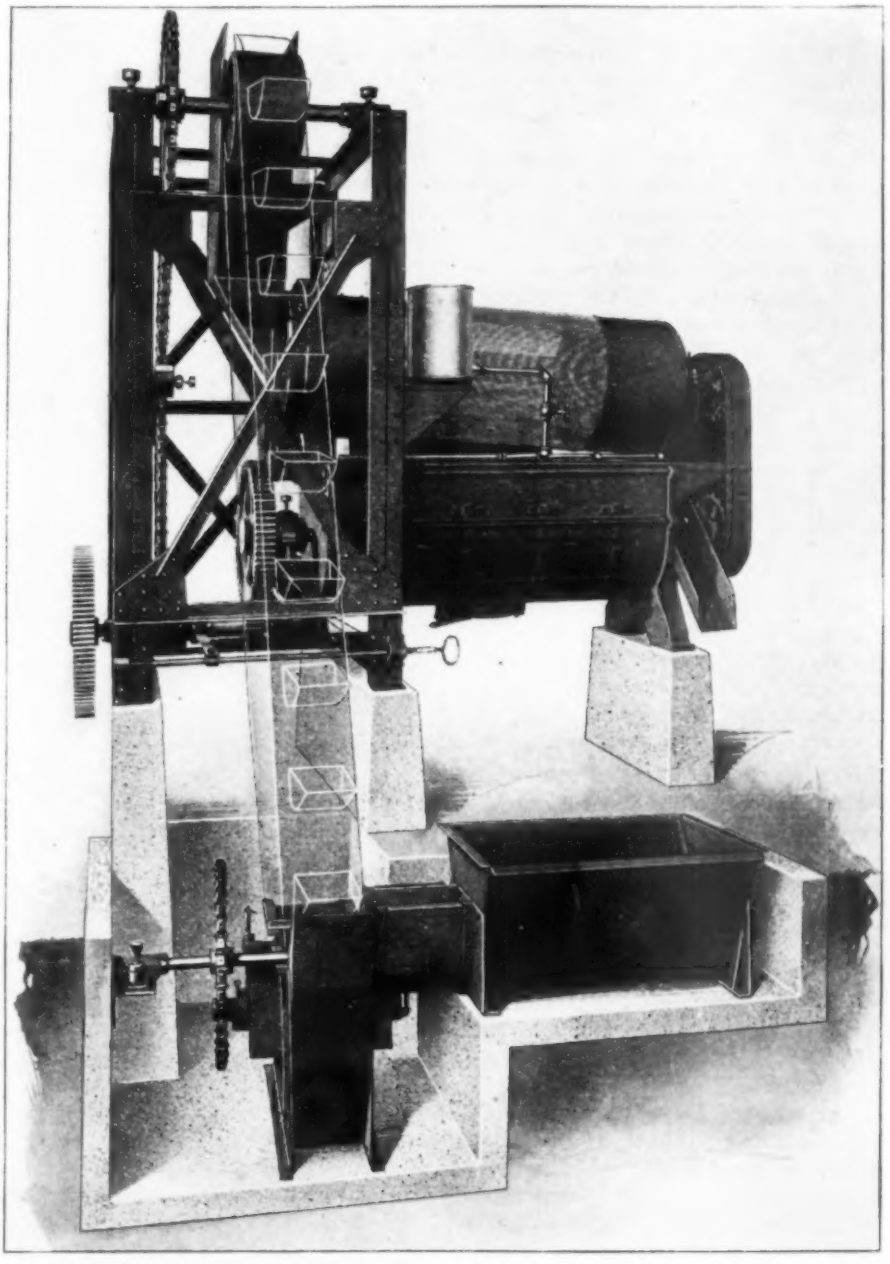
The paddle shaft is provided with Hyatt roller bearings housed in ball and socket retainers which are dust and dirt proof. The ball and socket feature insures perfect alinement of shaft and bearing. Instead of the usual chain, a rubber belt is used for carrying the buckets on the sand elevator.

Starting and stopping the elevator is effected through a square jaw clutch. By taking advantage of this arrangement the machine can be kept in continuous operation. The elevator and feed hopper may be stopped to receive a fresh batch of sand while the mixer is still running on the previous batch, thus conserving time.

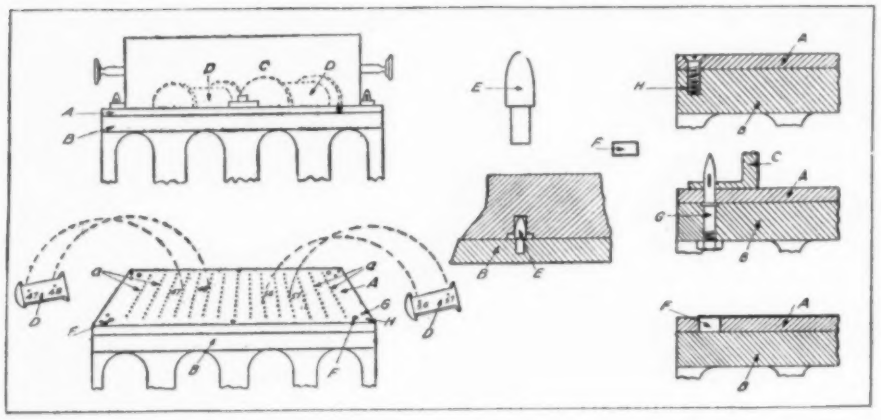
British Firm Takes Out a French Patent

A multiple plate extensively used at the plant of Vickers, Ltd., England has been made the subject of a French patent. As will be noted by referring to the illustration, the distinguishing feature of this plate is a number of rows of parallel holes distributed over the surface by means of which many miscellaneous patterns may be mounted on the plate at one time.

The whole surface of the pattern plate may be covered with a variety of different patterns with the assurance that the two half molds will fit together perfectly at the line where the two halves join. As the patterns are of ordinary construction there is no addition-



THE FEED HOPPER AND ELEVATOR ARE OPERATED INDEPENDENTLY OF THE MIXING TROUGH



SEVERAL MISCELLANEOUS PATTERNS CAN BE MOUNTED ON THE PATTERN PLATE AT ONE TIME

al expense in their manufacture. A pattern can be made in the ordinary manner and then molded either by hand or by machine as may be most convenient.

With this type of pattern plate it is necessary only to provide one size of flask and that size should be one to correspond to the maximum capacity of the machine. The flask can be filled with as many patterns as it conveniently will hold. In this manner a considerable economy is effected in the cost and supply of flasks required and also there is the assurance that the machine is working to its maximum capacity.

In the illustration, *A* is the pattern or indicator plate; *B* is the table of the molding machine; *C* is the flask and *DD* are two half patterns mounted on the pattern plate, *A*; *E* is one of the pins used for locating the patterns; *F* and *G* are blocks and guide pins used for locating the flask on the pattern plate. *H* is one of the screws employed for holding the pattern plate on the machine table. The rows of holes *aa* are drilled all over the pattern plate according to predetermined measurements.

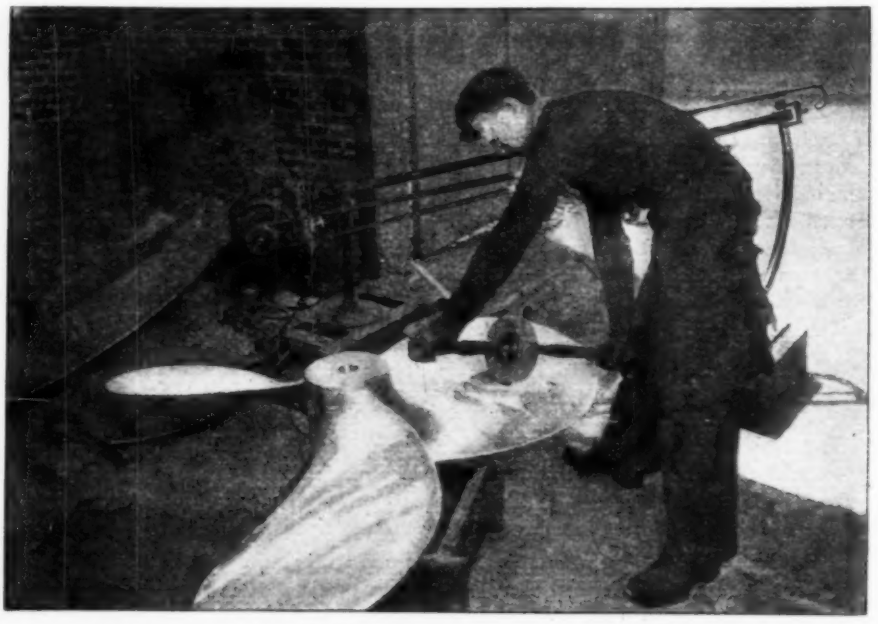
As is shown by the illustration, these holes are numbered. The various patterns destined to be used with the pattern plate also are furnished with pin holes *dd* numbered to correspond with the holes in the plate and indicating to the workman the relative position of the pattern on the plate.

Finishing Propellers with Abrasives

Abrasives play an important part in the manufacture of marine equipment as they furnish a ready means for finishing surfaces that under ordinary conditions cannot be machined without employing special equipment. Such an instance is shown in the accompanying illustration where the operation consists of finishing the blades of a bronze propeller. The blades should be smooth; otherwise the entire energy available is not utilized in driving the vessel through the water. Rough blades drag to a certain extent, that is, they carry an abnormal amount of water with them as they revolve. On the other hand, a propeller with smooth blades operates at high efficiency as the maximum amount of energy is utilized in propelling the vessel. In this instance, an excess amount of dead water is not rotated by the propeller.

The device shown in the accompanying illustration is a flexible shaft grinder made by the Stow Mfg. Co., Inc., Binghamton, N. Y. The device is driven by an electric motor mounted on the end of an arm while a pedestal supports the unit on a substantial base that is readily moved from place to place. Power is transmitted by a flat leather belt to a pulley at the end of the arm while a flexible shaft transmits power from the pulley to the grinding wheel arbor. In this case the abrasive medium used is a setup polishing wheel. With the propeller in position as shown, the operator can face one side of all three blades. Then by turning the propeller over, the other side is finished.

Another advantage in favor of polished propellers is that they do not become foul under ordinary conditions as the smooth surface does not afford a good hold for marine growths. The operation illustrated is one of many where a flexible shaft grinder can be utilized to advantage in grinding and polishing parts that are unwieldy.



FINISHING A PROPELLER WITH A FLEXIBLE SHAFT GRINDER

Obituary

Udolpho Snead, chairman of the board of Snead & Co., Jersey City, N, J., died in New York, April 19, following a long illness. Mr. Snead was born Dec. 5, 1843. He had little schooling and at 17 years of age started to work. In 1880, he went with Snead & Co., of which interest he later became president. For a period of about 10 years he was president of the Louisville Gas & Electric Light Co., Louisville, Ky., but otherwise spent his entire career with Snead & Co., he was president of the Snead Mfg. & Building Co., Louisville, and a director of some of the Louisville banks.

August D. Cook, founder and president of the firm of A. D. Cook, Inc., Lawrenceburg, Ind. died at his home in that city recently.

Adam Ehret, president and principal owner of the Crown Foundry Co., Belleville, Ill. died April 5, aged 62 years.

Inertia Rules in Foundry Equipment

Little Inclination Is Noted to Proceed with Foundry Extensions and Improvements Until Greater Stability is Found in Construction and Manufacturing Lines

APRIL has developed no improvement in foundry equipment sales. The same tendency is noted among buyers to offer inquiries freely, but few contracts result. Automotive activity has induced some buying of molding machines and finishing room machinery, but the effect has not been far-reaching. The present quiet has offered many the opportunity to remove their plants to districts which seem to hold out better operating conditions. A case of this nature is the Atlas Brass Co., Cleveland, which is building a new shop in Bellefontaine, O. and will remove to its new location about June 15. S. P. Fisher is president.

A feature of the market has been an inquiry from the Ford Motor Co., for a large number of molding machines. It is understood that 35 of these have been placed.

Slight Betterment in Chicago

ALTHOUGH various signs indicate slightly greater activity among foundries and more coke and pig iron is being used, sellers of equipment and supplies do not find much increase in demand for their goods. More inquiries are noted than previously, but these do not come to the point of buying, although considerable replacement and repairs are being planned. An engineering firm specializing in foundry building and planning finds a large volume of business offering, but its clients stop short of letting contracts. Automobile activity is having some effect, but in the aggregate has not brought much business.

Apathy Apparent in New York

DESPITE a fairly good number of new incorporations, demand for foundry equipment continues listless. Sellers assert that some tentative inquiry is developing as a result, but that these usually are withdrawn without any actual buying being done. Nevertheless, it is regarded as a rather significant development that there should be these new incorporations and it is believed that as soon as the general situation becomes more settled, considerable demand will result.

New plants and plant extension projects are few. One project before the trade is a foundry to be erected by the Plainville Casting Co., Plainville, Conn. The company was recently organized with a capital of $50,000, by Henry S. Washburn and William Stewart, formerly with the Torrington foundry, Torrington, Conn. Another project is that of the Chapman Valve Mfg. Co., Indian Orchard, Mass., for which equipment, including a 5 and 2-ton electric overhead crane, is being purchased.

Numerous small inquiries, especially for sand blast equipment, is coming out at this time, from Great Britain, but so far little business has resulted. The Keystone Equipment Co., 115 Broadway, New York City, reported recently as being in the market for complete equipment for a gray iron foundry to be erected in China, has not as yet closed. Possibly the largest company to be incorporated in the East recently is the P. & H. Pattern & Foundry Co., Trenton, N. J., which has been organized with a capital of $125,000. E. R. Patten is one of the incorporators. The Hall Zryd Foundry Co., Ltd., Hespeler, Ont., is asking for a number of second hand motors, 15 to 30 horsepower, 550 volt, 25 cycle, 3 phase, 750 revolutions per minute.

No Improvement in Pittsburgh District

SIGNS of improvement are not discernible in the Pittsburgh foundry equipment market and sellers are not at all encouraged over the outlook. Both manufacturers and sellers of equipment used in foundries report that inquiries are at a minimum and in some cases entirely absent. Occasionally small foundry supplies are ordered but these probably would be purchased in any event and such items as flasks, core ovens, coremaking equipment and molding machines are not being bought. At present one large manufacturer of molding machines reports the receipt of a few inquiries but these give no promise of turning into orders. Its chief activity now is in connection with selling repair parts and in making repairs, since many of the foundries are taking advantage of the lull to put their equipment in better shape. Foundry cranes are not being ordered and only occasionally is a hoist purchased where labor forces are being cut.

According to present plans of President D. H. Palmer of the Master Motors Corp., 504 Palace Hardware building, Erie, Pa., and his associates, a $500,000 plant for the manufacture of truck and tractor motors will be erected this summer. This company, which is incorporated under the laws of Delaware at $2,500,000, will build heavy duty motors for trucks and tractors, and marine engines as well as motors for drilling machinery. Officers in addition to Mr. Palmer are: Treasurer, C. F. Wallace, vice president Second National bank, Erie; vice president, G. V. Domarus, vice president Erd Motor Co., Saginaw, Mich.; and secretary, F. P. Armbruster.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

Truck bodies are to be manufactured in a plant to be erected by the Thompson Machine Shop, Foundry & Garage Co., Burlington, N. C., which was recently incorporated with a capital stock of $250,000.

The C. H. Mills Foundry Co., 2225 West Thirty-fifth street, recently was incorporated with a capital stock of $50,000, by Charles H. Mills and W. T. Mills. Baker, Holder &

Schmidt, 834 First National Bank building, Chicago, represent the company.

A foundry company is being organized at Springfield, O., by D. J. Sadlier, and others.

The Connersville Foundry Co., Connersville, Ind., is erecting an addition to its plant.

Contracts have been awarded by the Campbell Foundry Co., Harrison, N. J., for the erection of a factory building.

The Chapman Valve Mfg. Co., Indian Orchard, Mass., has received bids for the erection of a foundry building, 50 x 270 feet.

The plant of the Kenney Mfg. Co., Auburn, R. I., recently was damaged by fire. The company manufactures brass rods.

The plant of the Valley Falls Foundry Co., Valley Falls, R. I., recently was damaged by fire.

Enlargement of its plant is reported being contemplated by the Automotive Foundry Co., Freeland, Pa.

The Siegler Enamel Range Co., Belleville, Ill., recently was incorporated with a capital stock of $50,000, by Otto Siegler, John Borg, Leander Neubarth, and others. It will operate a foundry.

A. D. Cook, Inc., Greendale, Ind., recently was incorporated with a capital stock of $400,000, to manufacture pumping machinery, etc., by A. D. Cook, A. M. Cook and A. C. O'Brien.

Capitalized at $600,000, the Eastern Bronze Corp., Elizabeth, N. J., recently was incorporated by James S. Royce, Harris C. Bannister, Jersey City, N. J., and Harry S. Hecheimer.

The Springfield Brass Co., Springfield, Mass., has changed its name to the Springfield Brass & Iron Foundry Co. and has increased its capital stock from $80,000 to $100,000.

The Imperial Bearing Bronze Co., Flushing, N. Y., has been incorporated with a capital stock of $20,000, by L. Osafon, J. M. Partmann, J. Zentek and S. O. Wood.

Plans have been completed for the erection of an addition to the foundry of the Weir Stove Co., Taunton, Mass. The building will be 77 x 77 feet.

Capitalized at $50,000 the Concord Smelting & Refining Co., Boston, recently was incorporated by Nathan Kositsky, Concord, Mass., Bernard M. Edinburg and Samuel Friedman.

C. L. Hoey and A. J. Devoe were named as the incorporators of the Excelsior Valve Co., Saratoga Springs, N. Y., which was recently chartered with a capital stock of $40,000.

A brick and concrete building, 40 x 75 feet, will be erected at Fifteenth and Oklahoma avenues, Milwaukee, by the L. J. Mueller Furnace Co., 197 Reed street, Milwaukee, manufacturer of furnaces, stoves, etc.

The Renaissance Bronze & Iron Works, New York, recently was incorporated with a capital stock of $20,000, by B. M. Blumenthal, D. H. Schiffer and M. S. Rebarber, 261 Broadway, New York.

The Three B Gas Stove Co., Philadelphia, is being organized by Joseph P. and J. G. Kerrigan and George W. Scutter, to manufacture stoves, heaters, etc. The company is represented by Mr. W. Sloan, Drexel building, Philadelphia.

The Brass, Bronze & Copper Co., Superb building, Newark, N. J., has been organized to manufacture brass, bronze, etc., by Irving N. Schafman, 212 Elizabeth avenue, Newark, and others.

The Inland Iron Works, Inc., 103 McDonough street, Joliet, Ill., has been incorporated to manufacture engines, pumps, etc., with a capital stock of $50,000, by W. W. Hugins, Richard H. Thomas and L. G. Thomas.

The capital stock of the Fay & Bowen Engine Co., Geneva, N. Y., recently was increased in order to provide a stock dividend for the benefit of the stockholders. In addition some stock is to be sold which will provide additional working capital for the company, which manufactures engines and power boats. Officers are: President, W. L. Fay; vice president, W. C. Ware; treasurer, G. W. Gray, and secretary, J. M. Ward.

The Michigan Foundry & Machine Co., Detroit, recently changed its name to the Willis Piston Co.

Arrangements have been made for the sale of the plant and equipment of the Glass Foundry Co., Washington avenue, Milltown, N. J., now in the hands of a receiver.

The East Penn Foundry Co., Macungie, Pa., is reported planning the erection of an addition to its plant. At present it is giving employment to about 100 men.

The plant of the Ironton Stove Mfg. Co., Ironton, O., recently was damaged by fire. It will be rebuilt. J. E. Davis is president of the company.

The Richardson & Boynton Co., builders of boilers, furnaces and ranges, has moved its Boston offices and show rooms to larger quarters at 60 High street, that city.

The Fenton Foundry Supply Co., Dayton, O., recently was incorporated with a capital stock of $15,000, by William Fenton, E. P. Fenton, J. B. Fenton, and others.

The Canada Iron Foundries, Ltd., Ft. William, Ont., is contemplating establishing a wheelmaking plant to be operated as a subsidiary to its present plant.

The Oklahoma Pattern Works, Oklahoma City, Okla., plans the erection of a new plant building and will change its name to the Oklahoma Pattern & Brass Works.

The Dill Foundry Co., Rushville, Ind., is reported planning the erection of an addition to its plant, 40 x 100 feet. William Dill is secretary and treasurer of the company.

The Marion Machine, Foundry & Supply Co., Marion, Ind., recently organized, is reported planning to establish a plant in the vicinity of Eldorado, Ark.

Capitalized at $100,000 the National Valve Co., Morristown, N. J., recently was incorporated by G. F. Lowe, James H. Samuel and Edward A. Quayle Jr., to manufacture valves, etc.

The Novelty Brass Works, 840 South Los Angeles street, Los Angeles, has been organized to manufacture brass, bronze and other metal products, by Louis N. Auger, 1542 West Fifty-fourth street, Los Angeles, and others.

The Ellis Headgate & Valve Co., Los Angeles, recently was organized by J. W. Ellis and E. M. Crawford, 1100 Hibernian building, Los Angeles, to manufacture valves and kindred products.

Capitalized at $100,000, Radiated Bearings, Inc., 127 North Dearborn street, Chicago, recently was incorporated to manufacture and deal in bearings, etc., by A. A. McClanahan, A. N. McClanahan, W. J. Dukes and Clarence A. Foy.

The Jerome-Rothenbucher Valve Co., 3136 West Chicago avenue, Chicago, recently was incorporated with a capital stock of $60,000, by Robert and George C. Jerome and George E. R. Rothenbucher, to manufacture pumps, valves, etc.

P. J. Rice, 459 Layton boulevard, Milwaukee, has tentative plans for the erection of a new factory building for the Badger Brass Co., 243 Lake street, Milwaukee, manufacturer of brass and aluminum castings. Work probably will not be started until late in the summer.

A group of eight factory buildings will be erected on a 10-acre site for the All-In-One Co., 504 Marsh building, Los Angeles. The structures will include a pattern shop, 50 x 200 feet, a foundry, 50 x 200 feet, a 3-story enameling building, an assembling structure, warehouse, office building and clerical and rest room. The company was recently incorporated and will engage in the manufacture of sanitary bathroom fixtures, etc.

The Mortimer Foundry Co., 2443 West Twenty-first place, Chicago, has been incorporated to operate a foundry, by Arthur G. Mortimer, Maybelle M. Mortimer and William Mager.

Removal of the Atlas Brass Co. from Cleveland to Bellefontaine, O., is reported under consideration by owners of the company of which S. P. Fisher is president. It is stated the company will erect a new plant building in Bellefontaine which will be ready for occupancy about June 15.

The Plainville Casting Co., Plainville, Conn., recently incorporated with a capital stock of $50,000, has purchased a site fronting on the New Haven railroad, on which it plans to erect a foundry building. Henry S. Washburn and William Stewart, officers of the company, formerly were with the Torrington Foundry Co.

Capitalized at $200,000 the Atlas Die Casting Co., Inc., Worcester, Mass., recently was incorporated by Arthur M. Brewster, Brookline, Mass., Malcolm F. MacNeil and Allan Robinson, both of Boston, A. L. Kramer, Everett, Mass., and Elbridge G. Davis, Malden, Mass.

The Victory Motor Co. has reorganized under the name of the Victory Mfg. Co., Niles, Cal., by Charles S. James, H. J. James, E. W. McPherson, W. A. Wellington and Arthur E. Biggins. The new company has taken over the interest of the Victory Foundry Co. and the Victory Engineering & Sales Co., Rialto building, San Francisco.

The Maryland Car Wheel Co., Curtis avenue, Curtis Bay, Baltimore, recently was incorporated with a capital stock of $1,000,000, to succeed to the business of the Maryland Car Wheel Works. Plans are under way for the erection of plant additions. The incorporators of the company are Samuel H. McMillan, Raymond L. Berry and Donald H. Sherwood.

Pumps of all kinds, including oil fuel pressure, turbine-driven, dual-air, direct-acting feed and turbo-feed pumps, will be manufactured in a new foundry under construction at Ville La Salle, near Montreal, Que., for G. and J. Weir, Ltd. For the past 20 years these pumps have been imported from Glasgow, but since 1918 the Canadian subsidiary of the Weir company has been importing the parts and assembling them. With the operation of the new foundry, which is expected to be ready soon, the entire process of manufacture will be carried out in the vicinity of Montreal. It is proposed to begin operations in the foundry with a staff of 40 molders and the necessary complement of other workmen, but with the steady development of the port of Montreal it is anticipated more men will be employed and facilities enlarged. The Weir works in Glasgow cover 17½ acres and give employment to 2200 men.

According to present plans of President D. H. Palmer of the Master Motors Corp., 504 Palace Hardware building, Erie, Pa., and his associates, a $500,000 plant for the manufacture of truck and tractor motors will be erected in that city. The company, which is incorporated under the laws of Delaware with a capital stock of $2,500,000, virtually has taken over the plant and business of the Erd Motor Co., Saginaw, Mich., and plans to move it to Erie. Several plant sites are under consideration and at least six acres will be required. It is planned to expend approximately $150,000 on land and buildings and about $350,000 on equipment. In addition to heavy duty motors for trucks and tractors the company will build marine engines as well as motors for drilling machinery. Officers in addition to Mr. Palmer are: Treasurer, C. F. Wallace; vice president, G. V. Domarus, and secretary, F. P. Armbruster. Directors include D. W. Harper, O. E. Szelely and A. C. Palmer.